MONTHLY WEATHER REVIEW.

Editor: Prof. CLEVELAND ABBE.

VOL. XXXI. NOVEMBER, 1903. No. 11

INTRODUCTION.

The MONTHLY WEATHER REVIEW for November, 1903, is based on data from about 3300 stations, classified as follows:

Weather Bureau stations, regular, telegraph and mail, 166; West Indian Service, cable and mail, 15; River and Flood Service, 52, river and rainfall, 177, rainfall only, 62; voluntary observers, domestic and foreign, 2565; total Weather Bureau Service, 2962; Canadian Meteorological Service, by telegraph and mail, 20, by mail only, 13; Meteorological Service of the Azores, by cable, 2; Meteorological Office, London, by cable, 8; Mexican Telegraph Company, by cable, 3; Army Post Hospital reports, 18; United States Life-Saving Service, 9; Southern Pacific Company, 96; Hawaiian Meteorological Service, 75; Jamaica Weather Service, 130; Costa Rican Meteorological Service, 25; The New Panama Canal Company, 5; Central Meteorological Observatory of Mexico, 20 station summaries, also printed daily bulletins and charts, based on simultaneous observations at about 40 stations; Mexican Federal Telegraph Service, printed daily charts, based on about 30 stations.

Special acknowledgment is made of the hearty cooperation of Prof. R. F. Stupart, Director of the Meteorological Service of the Dominion of Canada; Mr. Curtis J. Lyons, Territorial Meteorologist, and Mr. R. C. Lydecker, Acting Territorial Meteorologist, Honolulu, H. I.; Señor Manuel E. Pastrana, Director of the Central Meteorological and Magnetic Observatory of Mexico; Camilo A. Gonzales, Director-General of Mexican Telegraphs; Capt. S. I. Kimball, Superintendent of the United States Life-Saving Service; Lieut. Commander W. H. H. Southerland, Hydrographer, United States Navy; H. Pittier, Director of the Physico-Geographic Institute, San José, Costa Rica; Commandant Francisco S. Chaves, Director of the Meteorological Service of the Azores, Ponta Delgada, St. Michaels, Azores; W. N. Shaw, Esq., Secretary, Meteorological Office, London; Rev. Josef Algué, S. J., Director, Philippine Weather Service; and H. H. Cousins, Chemist, in charge of the Jamaica Weather Office; Señor Enrique A. Del Monte, Director of the Meteorological Service of the Republic of Cuba.

Attention is called to the fact that the clocks and self-registers at regular Weather Bureau stations are all set to seventy-fifth meridian or eastern standard time, which is exactly five hours behind Greenwich time; as far as practicable, only this standard of time is used in the text of the REVIEW, since all Weather Bureau observations are required to be taken and recorded by it. The standards used by the public in the United States and Canada and by the voluntary observers are believed to conform generally to the modern international system of standard meridians, one hour apart, beginning with Greenwich. The Hawaiian standard meridian is 157° 30', or $10^h\ 30^m$ west of Greenwich. The Costa Rican standard of time is that of San José, $0^h\ 36^m\ 13^s$ slower than seventy-fifth meridian time, corresponding to $5^h\ 36^m$ west of Greenwich. Records of miscellaneous phenomena that are reported occasionally in other standards of time by voluntary observers or newspaper correspondents are sometimes corrected to agree with the eastern standard; otherwise, the local standard is mentioned.

Barometric pressures, whether "station pressures" or "sea-level pressures," are now reduced to standard gravity, so that they express pressure in a standard system of absolute measures.

FORECASTS AND WARNINGS.

By Prof. E. B. GARRIOTT, in charge of Forecast Division.

The marked features of the month were (1) the frequency of north Pacific coast lows, (2) the rapidity of storm movement, and (3) the cold wave of the 16-19th.

The forecasts and warnings were timely and as a rule accurate. The warnings issued in connection with the advance of the cold wave of the 16-19th over Texas and Louisiana were especially valuable to the sugar interests of those States. It is estimated that sugar cane to the value of $2,000,000 was cut in the thirty-six hours preceding the fall in temperature.

On the opening days of the month quiescent weather prevailed under the influence of an area of high pressure that had occupied the middle and eastern districts since October 27. On the night of the 2d, the official forecaster at the Central Office, Prof. E. B. Garriott, issued the following statement:

> Observation has shown that periods of low barometric pressure over the British Isles are attended by stagnated weather conditions over the western Atlantic and the eastern part of the American Continent, and that five to six days after reestablishment of normal barometric pressures over the eastern Atlantic, the usual progression of areas of high and low barometer over the United States is resumed. An instance of this kind has been presented during the past week. On Friday last an area of low barometer that had occupied the British Isles for several days began an eastward movement, and to-day the high barometer area that has persistently occupied the east-central part of the United States since last Tuesday shows signs of dissolution. The effect of these barometric changes will probably be shown in a gradual breaking up of the quiescent weather conditions that have prevailed since the 27th ultimo over the eastern part of the United States. There are at present, however, no indications of the development of a well-marked storm in the United States.

The p. m. reports of the 3d gave the first indications of renewed storm activity. A moderate depression then appeared off the Washington and Oregon coasts, and at the same time an area of high pressure began a southeasterly movement from Alberta. To the eastward of the last-named area, a shallow depression deepened somewhat and moved eastward, forming an elongated trough-like disturbance that passed off the Atlantic coast on the 5th. It was accompanied by general rains from the Mississippi Valley eastward and snows in the Lake region and northern portion of the Middle Atlantic States and New England.

In Washington the snow was the earliest noted since 1891, when snow fell on November 5. The average date of first snow in Washington is November 21, the earliest date October 14, 1876, and the latest date December 29, 1871.

The north Pacific coast storm of the 3d moved slowly inland and inaugurated a period of rainy weather in Washington and Oregon, that persisted with but few interruptions until the end of the month. Its movement eastward was very slow; it reached its maximum development on the morning of the 6th, with a barometer reading of 29.20 inches at Edmonton, and passed beyond the field of observation on the 7th. A second area of low pressure apparently developed over the Plateau

region on the morning of the 7th. It moved eastward to the Missouri Valley, where it was central on the morning of the 8th, thence northeasterly, passing over Lake Superior and down the St. Lawrence Valley, disappearing on the evening of the 10th over the Canadian Maritime Provinces.

On the 6th an energetic storm developed over the western North Atlantic. It reached its maximum strength on the morning of the 7th, with a barometer reading of 29.54 inches, and a maximum wind velocity from the northeast of 48 miles per hour on the Maine coast. This storm diminished in energy and passed eastward over the Atlantic Ocean from the 7th to the 10th.

From the 7th to the 10th the eastern districts were occupied by the area of high pressure that first appeared in Alberta on the evening of the 3d, and drifted slowly eastward, reaching the Lake region by the 6th. On the morning of the 10th pressure had fallen over the East and South, and a faint depression appeared off the North Carolina coast. This depression apparently moved northeastward over the Atlantic without affecting the coast districts.

On the 11th there began a series of extremely rapid barometric movements across the northern portion of the country. At that time an area of low pressure of considerable magnitude was central off the Washington coast, with a barometer reading of 29.00 inches at Tacoma. On the next morning this depression had moved to Iowa, a distance of about 1500 miles in twenty-four hours. On reaching Iowa, it curved northeastward, passing over Lake Superior on the evening of the 12th and disappearing north of that region on the morning of the 13th. On the evening of the 13th, a second North Pacific disturbance appeared off the Washington and Oregon coasts with a barometer reading of 29.50 inches at Portland. This storm increased in energy and was central on the morning of the 14th off the Washington coast, with lowest pressure, 29.30 inches, at Seattle. On the evening of that date, an offshoot of the main low appeared over northeastern Nevada, and in twelve hours it had moved to western Kansas. Its course was thence northeasterly, reaching lower Michigan on the morning of the 16th. Its rate of progression on the 16th, 17th, and 18th was greatly diminished, and it passed off the Atlantic coast on the last-named date as a trough-like depression, with barometer readings of 29.80 to 29.90 inches. The period of rapid movement was brought to a close by the southeasterly movement of an area of high pressure that first appeared on the morning of the 15th in Alberta. Zero temperatures, with snow, prevailed throughout Alberta and northern Montana, and the high spread southeastward and southward along the northern Rocky Mountain slope and over the eastern slope, reaching northern Texas by the morning of the 17th, and the Gulf coast and Ohio Valley by the morning of the 18th. By the morning of the 19th it had reached the Atlantic coast districts and northern Florida. Frost occurred on the Gulf coast and in northern Florida on the 19th, with minimum temperatures of 30° and 36° at New Orleans and Mobile, respectively, the lowest on record for the second decade of November. The pressures recorded in connection with the advance of this cold wave were remarkably high. A reading of 31.00 inches was recorded at Havre, Mont., on the morning of the 17th, and of 30.80 inches at Dodge City, Kans., on the morning of the 18th. The barometric reduction tables that have been in use since January 1, 1902, give sea-level pressure on the Plateau and in the Rocky Mountain regions that are probably two to three-tenths of an inch lower than those obtained in this case by using the Hazen tables. It is, therefore, impossible to make a direct comparison of the recorded barometric heights during the progress of the cold wave above noted with those that have previously occurred in the same regions. This high dominated the weather of the United States from the 16th to the 22d, although in the meantime an area of low pressure had advanced from the Oregon coast, where it was central on the 18th, to the Lake region, where it disappeared on the morning of the 22d.

The second series of rapid storm movement across the northern border began on the morning of the 23d. On the evening of the 22d a shallow depression covered Minnesota. This depression developed considerably during the night, and by the morning of the 24th it had moved to the lower St. Lawrence Valley, with lowest pressure, 29.42 inches, at Father Point and Quebec, respectively. It remained almost stationary over the Canadian Maritime Provinces during the 25th and gradually filled up during the next forty-eight hours.

A faint depression appeared on the morning map of the 24th, central over New Mexico. This depression moved slowly southeastward, and thence eastward along the Gulf coast, reaching Florida by the evening of the 25th, and disappearing over the Atlantic on the next day.

An area of high pressure that had been slowly moving southeastward from the eastern slope region, reached the Mississippi Valley by the evening of the 26th, and continued its southeastward movement during the 27th. It brought frost and freezing temperatures in the Gulf States and northern Florida on the mornings of the 27th and 28th. On the last-named date, minimum temperatures of 26° at Jacksonville, 32° at Tampa, and 36° at Jupiter were recorded. These values were as low, or lower, than any that had heretofore been recorded during the last decade of November.

The advance of lows from the North Pacific continued uninterruptedly until the end of the month. Pressure was low on the north Pacific coast and over British Columbia on the 25th and 26th. By the evening of the 26th it had fallen over the Missouri Valley, and by the evening of the next day a well-marked depression was central over western Minnesota. This depression increased in intensity during the next twelve hours and moved eastward, the southern end much faster than the northern, so that by the morning of the 29th, one center appeared off the Carolina coast and a second center over the northern portion of lower Michigan. The coast storm moved northeastward as an independent area of low pressure and the Lake region depression followed in its rear at a much slower rate of progression.

The winter type of high pressure over the Plateau region was established on the morning of the 26th and continued until the close of the month.

BOSTON FORECAST DISTRICT.

In many respects November was an ideal month, as there was a preponderance of fair weather, with fifteen clear days. The first half of the period was warm, while during the last half the temperature was below normal, making the monthly mean somewhat below the normal. The precipitation was decidedly deficient, except in extreme eastern Maine where it was about the normal. There were no severe or long-continued high winds, and, therefore, no damage and little delay to shipping. Storm warnings were displayed on the 5th, 7th, 11th, 15th, 24th, and 27th. No storms occurred without warnings.—*J. W. Smith, District Forecaster.*

NEW ORLEANS FORECAST DISTRICT.

The month was remarkable in some respects. Very little rain fell in any part of the district during the month; rain conditions appeared on the map several times, but they passed off without rain or only inappreciable amounts.

Unprecedented cold weather for the season of the year prevailed over parts of the district on the 18th and 19th. Cold-wave warnings were ordered for Oklahoma on the 16th and were extended to the Gulf coast during the 17th and 18th. Sugar planters and truck growers in Louisiana and Texas were warned on the morning of the 17th to prepare for tem-

peratures of 27° to 30° on the 18th, and on the morning of the 18th they were advised to prepare for a temperature of 25°, which implied a cane-splitting freeze.

The warnings were widely distributed, not only by the Bureau, but by private individuals interested in the sugar crop. The temperature on the morning of the 19th ranged from 22° to 29° in different parts of the sugar and truck growing region.

The following comment from The Daily Picayune of November 19, 1903, concerning the warnings, is of interest.

Sugar planters have been warned by the Weather Bureau to prepare for temperatures as low as 25°, and reports received seem to indicate that they are acting in accordance with the warnings and protecting the cane crop. A temperature of 25° so early in the season would damage the cane crop to the extent of millions of dollars unless protection is accomplished. Since sugar cane grows richer in sugar contents with every day that it is allowed to grow, many planters cut their cane only as fast as they can manufacture sugar. In some seasons grinding is completed without a freeze, and the cane harvested at the close of the season gives much greater production than that harvested at the opening of the season. With a feeling of certainty that he will be warned by the Weather Bureau of an approaching freeze in time to enable him to protect his crop, the planter lets his cane grow until warned by the United States Weather Service to protect his crop. The Weather Bureau has in the past saved millions of dollars to the sugar planter, for there has not been a freeze in recent years but what the lowest temperature which occurred has been announced in warnings issued twenty-four to thirty-six hours in advance of its occurrence.

I. M. Cline, District Forecaster.

CHICAGO FORECAST DISTRICT.

Cold waves.—The month was marked by moderate temperature throughout the first half. The first well-defined cold wave and winter type appeared in the extreme northwest on the morning of the 15th. It moved slowly southward and eastward, following an area of low barometer which had crossed the middle Rocky Mountain region from the Pacific coast. By the morning of the 16th, the cold was felt quite generally west of the Missouri Valley. It continued to increase in intensity, and by the morning of the 17th had overspread the entire district. Exceptionally cold weather prevailed in Montana and zero temperatures occurred in portions of North Dakota, South Dakota, and Minnesota. Warnings of the cold wave were sent to all points in the forecast district on the 15th, and all interests were advised that the first severe cold spell of the winter was approaching.

Storm warnings on the Lakes.—The weather on the Lakes was marked by frequent storms, more or less severe, and storm warnings were displayed many times during the month. The advices of the Weather Bureau were generally closely followed, and but two wrecks of consequence occurred.

The steamer *Walter L. Frost* went ashore on South Manitou Island during the storm of the 9th and 10th, and the vessel and cargo, valued at $75,000, were a complete loss. The most serious wreck was that of the new steel steamer *J. P. Hutchinson*, which went ashore near Keweenaw Point on the night of November 29 in a northerly gale and snowstorm. The steamer missed the entrance to the Portage Lake canal and went on the rocks. It is badly damaged and may be a total loss. The vessel and cargo of flax seed are valued at nearly $400,000. Storm warnings were displayed on Lake Superior for two days previous to this wreck, and danger signals were flying at Duluth when the vessel left port.

Snowstorms.—No general heavy snowstorms occurred during the month, but the considerable falls of snow were confined to the upper Lake region, and were due to the influence of the moist Lake winds. The Upper Michigan Peninsula was visited by several heavy snowstorms.

Considerable snow fell over a portion of the city of Chicago on the 26th. The maximum depth of snow reported was 11 inches at South Chicago. A fall of half an inch occurred in the downtown district, while west of Halsted street, a mile away, not even a flurry was seen during the entire day. The observer at Port Huron states that a storm of a similar character visited his city on the same day, and another local snowstorm occurred in Port Huron on the 6th.—*H. J. Cox, Professor and District Forecaster.*

DENVER FORECAST DISTRICT.

November was not only dry throughout the district, but unusually mild, except from the 16th to the 19th, during which period very low temperatures spread over the greater part of the district.

For several days prior to the 15th a deep low remained central in the Pacific northwest. The p. m. charts of the 14th gave indications of a southeastward movement, and on the morning of the 15th the depression was central in northern Colorado. A warning of a cold wave was then sent to points in Wyoming and eastern Colorado and of a moderate cold wave in southern Utah and northern Arizona. By the morning of the 16th a sharp fall in temperature had occurred in southern Utah and northern Arizona and strong anticyclonic conditions had developed over the British Northwest Territory, giving a steep gradient over the district and a decided fall in temperature on the middle-eastern slope, extending on the 17th to southern New Mexico. The warnings were timely and doubtless of considerable value to live stock interests.—*F. H. Brandenburg, Forecast Official.*

SAN FRANCISCO FORECAST DISTRICT.

A rainless period of nearly two hundred days, with the exception of two days in October, was brought to a close by a storm of moderate intensity on November 4. Rain fell in generous amounts over central and northern California. Southeast storm warnings were displayed from the Southeast Farallon northward to Eureka on the morning of November 3. Southerly winds exceeding 40 miles occurred on the evening of November 3 and the morning of November 4. On November 11 the first well-marked coast storm of the winter occurred. Southeast storm warnings were displayed from Port Harford northward on the morning of November 11. The storm moved southward, as expected, to northern California and then rapidly eastward. Generous rain fell throughout central and northern California. High southerly winds were reported at nearly all stations north of the Tehachapi. Southeast storm warnings from San Francisco to Eureka were displayed on the morning of November 13 and continued on November 14. The warnings were amply verified. Southeast storm warnings were displayed on November 18 and were verified. A moderate disturbance moved southward along the northern coast, but, as in the case of the previous storm, was prevented by an area of high pressure over southern California from passing farther south.

A thunderstorm occurred at San Francisco on the morning of November 23. No rain fell during the month in southern California.—*Alexander G. McAdie, Professor and District Forecaster.*

PORTLAND, OREG., FORECAST DISTRICT.

The weather in the North Pacific States during November was very stormy, with excessive precipitation and normal temperature. No extremely cold weather occurred and no cold-wave warnings were issued.

Several severe storms passed eastward over the district during the month, and timely warnings of their approach were given by this office. The storms of the 5th, 9th, 11th, and 14th were the most noteworthy, and unusually high winds accompanied their movement.

On the night of November 5 the steam schooner *Charles Nelson*, loaded with lumber and en route from Westport, Oreg., to San Pedro, foundered off the southern Oregon coast

and was abandoned by the crew. The *Nelson* left Astoria on November 3, and southeast storm warnings were displayed at all stations at the mouth of the Columbia River when the vessel put to sea. The captain reports encountering a severe storm on the night of November 4, which increased in energy and finally resulted in wrecking his vessel.

On November 9, the schooner *C. A. Thayer* went ashore at the entrance to Grays Harbor during the gale of that date. A gale of 90 miles an hour from the southeast occurred at North Head on the morning of the 9th. The masters of incoming vessels all report having experienced gales of hurricane force near the American coast, which did much damage in carrying away masts, rigging, hatches, lifeboats, etc. With the exception of the *Charles Nelson*, however, the disasters caused by the storms were almost exclusively confined to inward-bound shipping.

The forecasts for this district were made by District Forecaster Edward A. Beals from the 1st to the 5th, inclusive, and by Observer A. B. Wollaber during the remaining days of the month.—*A. B. Wollaber, Acting District Forecaster.*

RIVERS AND FLOODS.

No floods of consequence were reported during the month, and there was but a single stage above a danger line recorded, namely at Red Bluff, Cal., where a stage of 24.5 feet, 1.5 feet above the danger line was reached as a result of exceptionally heavy rains that lasted from the 19th to the 22d, inclusive, and amounted to about 5.50 inches. Warnings were issued on the 20th, advising the removal of live stock and care of the levees.

The stages of the Mississippi River, like those of the corresponding period of the preceding year, were above the average for the season below the mouth of the Missouri River, and they were also higher above the mouth of the Ohio River than during October. The Missouri River changed but little, while the Ohio was higher. The Tennessee was too low for navigation, except for the week from the 18th to the 24th, inclusive, and at the close of the month 85,000 cross-ties were lying on the bank of the river at Florence, Ala., awaiting sufficient water for shipment.

Floating ice was observed in the Mississippi River at St. Paul, Minn., on the 18th, reaching Hannibal, Mo., on the 25th, and continuing until the 30th. The Missouri River at Bismarck, N. Dak., froze over on the 17th. Floating ice had previously been seen as early as the 13th. The ice reached Pierre, S. D., on the 15th, and closed the river on the 18th. Running ice was observed at Sioux City, Iowa, from the 17th to the 19th, inclusive, and the river gage was frozen in on the former date.

The James River, Northwest, also froze over on the 17th, while the Red River of the North, at Moorhead, Minn., closed on the morning of the 27th. The Penobscot River, at Mattawamkeag, Me., closed on the 26th; the Merrimac, at Concord and Manchester, N. H., on the same date. The ice went out two days later, however, at the latter place. The Connecticut River at Wells River, Vt., froze over on the 21st, and floating ice was quite plentiful at all points below, forming a small gorge above the bridge at Hartford, Conn., on the 28th.

The departure on the 30th of the steamboat *Dean Richmond*, from Albany, N. Y., marked the close of through navigation for the season on the Hudson River.

At the end of November, 1902, very little ice had been observed in the various rivers.

The highest and lowest water, mean stage, and monthly range at 183 river stations are given in Table VII. Hydrographs for typical points on seven principal rivers are shown on Chart V. The stations selected for charting are Keokuk, St. Louis, Memphis, Vicksburg, and New Orleans, on the Mississippi; Cincinnati and Cairo, on the Ohio; Nashville, on the Cumberland; Johnsonville, on the Tennessee; Kansas City, on the Missouri; Little Rock on the Arkansas; and Shreveport, on the Red.—*H. C. Frankenfield, District Forecaster.*

AREAS OF HIGH AND LOW PRESSURE.

Movements of centers of areas of high and low pressure.

Number.	First observed.			Last observed.			Path.		Average velocity.	
	Date.	Lat. N.	Long. W.	Date.	Lat. N.	Long. W.	Length.	Duration.	Daily.	Hourly.
High areas.		°	°		°	°	*Miles.*	*Days.*	*Miles.*	*Miles.*
I	2, p. m.	54	114	9, p. m.	39	75	3,050	7.0	436	18.1
II	8, a. m.	43	123	10, a. m.	35	85	2,150	2.0	1,075	44.8
III	12, p. m.	51	114	15, p m.	35	76	2,450	3.0	816	34.0
IV	16, a. m.	54	114	22, a. m.	46	60	3,775	6.0	629	26.2
V	25, a. m.	50	97	28, a. m.	28	83	1,900	3.0	633	26.4
VI	28, a. m.	51	114	*1. a. m.	37	81	2,575	3.0	858	35.8
Sums							15,900	24.0	4,447	185.3
Mean of 6 paths							2,650		741	30.9
Mean of 24.0 days									662	27.6
Low areas.										
I	4, a. m.	48	89	6, a. m.	46	60	1,500	2.0	750	31.2
II	5. p. m.	41	70	8, a. m.	46	60	725	2.5	290	12.1
III	6, p. m.	54	114	10, p. m.	48	68	2,800	4.0	700	29.2
IV	9, p. m.	54 43	114 109	11, p. m.	48	86	1,800 1,700	2.0	900 850	37.5 35.4
V	11, a. m.	47	123	13, a. m.	48 35	86 97	2,275 1,900	2.0	1,136 950	47.3 39.6
VI	14, a. m.	47	123	17. p. m.	48	68	3,100	3.5	886	36.9
VII	21, a. m.	48	125	25, a. m.	50	64	3,050	4.0	762	31.8
VIII	23, p. m.	37	117	25, p. m.	30	82	2.250	2.0	1,125	46.9
IX	27, a. m.	54	114	30, a. m.	42 47	80 65	2,225 3,375	3.0	742 1,125	30.9 46.9
Sums							26,700	25.0	10,216	425.7
Mean of 12 paths							2,225		851	35.5
Mean of 25.0 days									1,068	44.5

* December.

For graphic presentation of the movements of these highs and lows see Charts I and II.—*George E. Hunt, Chief Clerk, Forecast Division.*

CLIMATE AND CROP SERVICE.

By Mr. JAMES BERRY, Chief of Climate and Crop Service Divison.

The following summaries relating to the general weather and crop conditions during November are furnished by the directors of the respective sections of the Climate and Crop Service of the Weather Bureau; they are based upon voluntary reports from meteorological observers and crop correspondents, of whom there are about 3000 and 14,000, respectively:

Alabama.—The first half of the month was warm and favorable, but the latter half was much colder than the average. The rainfall was deficient, particularly in the central counties. A severe cold wave on 19th damaged recently sprouted wheat and oats and fall gardens, and killed some very late cotton on lowlands; cotton mostly marketed. About an average acreage of wheat and oats indicated, early sown doing well.—*F. P. Chaffee.*

Arizona.—Rainless weather prevailed throughout the entire month, making, with the rainless weather of the greater portion of October, an exceptionally long dry spell. Temperatures averaged above normal. There was an abundance of feed on ranges, due to the good rains of the latter part of September, and this was well cured as hay by the dry weather. Stock was in excellent condition, but the supply of water was diminishing, causing fear of suffering unless rain came soon.—*M. E. Blystone.*

Arkansas.—The unusually cool and dry weather was favorable for gathering outstanding crops, but was too dry for plowing, seeding, and germination. Cotton picking well advanced, probably 80 per cent completed; the yield was light. Corn all gathered; yield average. Irish and sweet potatoes made good crops, and harvesting was nearly completed. Less than usual acreage sown to small grain. Pastures dried up and stock water was scarce, but an abundance of winter feed was secured and stock was generally thrifty.—*Edward B. Richards.*

California.—Weatner conditions were nearly normal during the month,

except in Southern California, where a marked dry period prevailed. Heavy rains fell in the central and northern portions of the State, causing a rapid growth of grass and early sown grain, and softening the soil for cultivation. Nearly all crops were under cover before the beginning of the rains. Heavy frosts occurred toward the close of the month, but caused no material damage.—*Alexander G. McAdie.*

Colorado.—Conditions were unusually favorable for finishing the harvest of the few outstanding crops. There was a pronounced scarcity of precipitation, and plowing, seeding, and germination were prevented by the dryness. Over the eastern ranges the low temperatures of the 16th to 20th caused some shrinkage in live stock, but otherwise conditions were favorable, and at the close of the month cattle, horses, and sheep were reported as being in prime condition, excepting along the eastern foothills, where the ranges were poor. In parts of the southeastern quarter the supply of stock water was low.—*F. H. Brandenburg.*

Florida.—Frosts were frequent, general, and severe during the month. On the 27th and 28th freezing weather prevailed over half of the State, and unprotected products such as vegetables and cane were damaged. Some exposed oranges in the north and north-central portions were reported frosted, and some tender growth was slightly damaged. As a whole, the orange crop suffered no material damage. At the close of the month rain and warmer weather were needed.—*A. J. Mitchell.*

Georgia.—The first half of the month was comparatively mild, but the latter part was unseasonably cold. The precipitation for the State at large was slightly under the usual amount, but it was above the average in the southern section. The severe weather during the latter part of the month destroyed all late cotton, although the bulk of the crop was secured before that time. Seeding wheat, oats, and rye continued under generally favorable conditions.—*J. B. Marbury.*

Idaho.—Temperature averaged somewhat above normal over most of the State; precipitation averaged slightly above normal; heavy snow fell at high elevations, and some in the valleys, from the 8th to the 16th; much of this snow melted later in the month. Considerable plowing was done. Winter range was generally good at the close of the month, and stock was in fair to good condition. Hay was in good demand.—*S. M. Blandford.*

Illinois.—As the husking and garnering of corn proceeded the quality was found to be very uneven. A considerable quantity was soft and sappy, and complaint was also made of chaffy condition and light weight. Wheat was not generally in a thrifty state, the lack of moisture having retarded seasonal growth. Pasturage was short and meadows were affected by droughty conditions. Apples and potatoes in storage were not keeping well.—*Wm. G. Burns.*

Indiana.—There were several abnormally warm days during the early part of month, but cold periods occurred on the 6th to 7th, 17th to 19th, and 24th to 30th. Precipitation was about half the normal amount. Good progress was made in cribbing corn; yield below average. On account of dryness wheat was small, in many fields stand poor and some damaged by flies. There was a light covering of snow on the ground throughout State at the end of the month.—*W. T. Blythe.*

Iowa.—November was very dry, with normal temperature and no severe storms. The weather was very favorable for harvesting the corn crop, the bulk of which was cribbed in good condition, though the cobs contained more than the usual amount of moisture. Fall wheat and rye (acreage small) do not show material injury from low temperature and dry weather. The fall has been unusually favorable for stock feeding and usual farm operations.—*John R. Sage.*

Kansas.—The wet weather of the first few days of the month greatly benefited the seed wheat in the ground and the growing wheat; the dry weather following was very beneficial to corn gathering. Wheat was in good condition and growing, except that the early wheat was damaged by the fly in Clay and Ottawa counties, and in some fields in Sedgwick; it was being pastured in Kingman. Corn dried out well and much was gathered. Cattle were in good condition.—*T. B. Jennings.*

Kentucky.—The first half of month was warm, with abundant rainfall, but the latter part was quite cool and dry. Wheat, oats, and rye made good growth during the early part of the month, but the cold dry weather which followed checked their growth, and they went into the winter in only fair condition. No reports of damage by the Hessian fly have been received. Very few sudden changes in temperature occurred and no damaging conditions prevailed. Fruit trees appeared to be doing well.—*H. B. Hersey.*

Louisiana.—An unusually severe drought prevailed during the month which, following a marked deficiency in precipitation, made it impossible to complete fall plowing and planting. The unprecedented early freeze, November 19, 1903, with temperatures of 22° to 29° in the sugar region, killed sugar cane except on the immediate coast. Warnings issued by the Weather Bureau on the 17th and 18th, advising planters to prepare for temperatures of 27° to 30° on the 18th, and 25° on the 19th, were heeded generally. Sugar cane to the value of about $2,000,000 was windrowed and protected through the freeze. The cane crop was giving a very light tonnage, but a good sugar yield was reported. Grinding was suspended while the crop was being windrowed, but good progress was reported. Cotton was about all gathered. Corn was housed in good condition.—*I. M. Cline.*

Maryland and Delaware.—Low temperature and insufficient rainfall hindered all growth. Wheat suffered most from these inclemencies and was very backward; early sown wheat was in fairly good condition, though short, but late wheat was poor. The dry weather favored the curing of corn and tobacco. Corn husking nearly completed; the quality of the fodder was good. Pasturage was short. The soil was in bad condition, and plowing not well advanced.—*Oliver L. Fassig.*

Michigan.—The weather during November was generally cool and dry, and forwarded sugar beet harvest and corn husking, but retarded the growth of winter wheat and rye. The wheat and rye were sown rather late this year and germinated finely. Wheat rooted well and at the end of the month looked healthy, but was rather small. A few correspondents reported Hessian fly in wheat, but this condition was not general.—*C. F. Schneider.*

Minnesota.—November opened warm, with such hardy plants as clover and sweet peas still green. After the 5th there was a gradual fall in temperature, which reached zero in northern portions the first time this season on the 17th, and in southern portions on the 26th. Nearly all the precipitation of the month occurred after the 8th, and it was practically all snow. Sleighing was general in the north on the 23d, but in the south there was not enough snow to cover the ground. Shallow lakes in the south were frozen over on the 15th, and they continued closed with ice. The Mississippi was covered with ice heavy enough to stop the Minneapolis saw mills on the 17th. There was a cold wave on the 24th. Plowing was generally stopped before the middle of the month; thrashing was nearly finished, and corn husking was progressing satisfactorily at the end of the month.—*T. S. Outram.*

Mississippi.—The fore part of the month was unusually warm, and the latter part very cool with unprecedentedly low temperatures for November. The drought which prevailed over the greater portion of the State during September and October continued unbroken. The freeze on the 19th injured sugar cane in the southern portion of the State. Cotton picking was about completed, except in a few Delta counties, where there remained in the fields from one-fourth to one-third of the crop; the yield was considerably below the average. Fall crops were a total failure and little or no fall plowing or seeding was done. Stock water was very scarce. Forest fires were numerous.—*W. S. Belden.*

Missouri.—November was cool and exceptionally dry. In the eastern and southern counties wheat made little growth, and in localities looked very unpromising. In some of the southern counties much of that sown during the latter part of October was not up at the close of November. In the northern and western counties, however, the crop was generally reported in good condition. Corn gathering progressed favorably and was about two-thirds completed at the close of the month.—*A. E. Hackett.*

Montana.—The month was mild until the 7th, then quite cold, with intermittent snows, until the 19th; during the remaining days the temperature was moderate and the snowfall very light. Stock suffered somewhat during the period of cold, snowy weather, but not to any great extent, and the snow will prove much more of a benefit than a detriment.—*Montrose W. Hayes.*

Nebraska.—Rain on the first four days of November was very beneficial to winter wheat and placed soil in western counties in condition for seeding, and considerable wheat was sown. Wheat in eastern counties was in good condition, but made a rather short growth; in western counties some wheat was not up and much was very small. The dry weather with moderate temperature which followed the rain was very favorable for completing fall work. Corn husking progressed rapidly and from one-half to two-thirds of the crop was generally secured by the end of the month.—*G. A. Loveland.*

Nevada.—The weather of the month was moderately mild and generally favorable for stock and for the farm work usual at this time of the year. High winds from the 11th to 15th did more or less damage to trees, fences, and farm property in various parts of the State. Winter range feed rather poor; live stock in fair condition generally.—*J. H. Smith.*

New England.—Excepting November, 1894, the month was the coldest of its name in the history of the New England section, Climate and crop service. The first week was exceptionally warm and the last unusually cold. There was a marked deficiency in the precipitation, which resulted in very low water in streams and ponds; water power mills shut down for want of water and in parts of Maine farmers were much inconvenienced by the low water in wells, springs, and streams.—*J. W. Smith.*

New Jersey.—Wheat, rye, and grass sown early obtained a promising stand; that sown from two to four weeks later than usual (principally in southern section) was very poor. The severe freezing weather retarded germination and some field were bare. Pastures continued good up to close of the month. Husking of corn was about completed, yield generally below the average.—*Edward W. McGann.*

New Mexico.—Hardly a trace of precipitation excepting on mountain ranges, since last of September. Food and water very short on stock ranges, but owing to open weather thus far and the excellent curing of what grass there was stock generally was in very good condition. Water in wells and streams was also very low.—*R. M. Hardinge.*

New York.—Wheat and rye generally covered with snow; good growth especially of the early sown and all in good condition; acreage less than expected. Favorable weather for farm work during first half of month; latter half cold with frequent snows.—*R. G. Allen.*

In the following table are given, for the various sections of the Climate and Crop Service of the Weather Bureau, the average temperature and rainfall, the stations reporting the highest and lowest temperatures with dates of occurrence, the stations reporting greatest and least monthly precipitation, and other data, as indicated by the several headings.

The mean temperatures for each section, the highest and lowest temperatures, the average precipitation, and the greatest and least monthly amounts are found by using all trustworthy records available.

The mean departures from normal temperature and precipitation are based only on records from stations that have ten or more years of observation. Of course the number of such records is smaller than the total number of stations.

Summary of temperature and precipitation by sections, November, 1903.

Section.	Temperature—in degrees Fahrenheit.								Precipitation—in inches and hundredths.					
	Section average.	Departure from the normal.	Monthly extremes.						Section average.	Departure from the normal.	Greatest monthly.		Least monthly.	
			Station.	Highest.	Date.	Station.	Lowest.	Date.			Station.	Amount.	Station.	Amount.
Alabama	51.1	−2.6	Evergreen Fort Deposit	85 85	14 15	Riverton Valleyhead	12 12	19 27	2.12	−1.46	Dothan	5.79	Selma	0.17
Arizona	55.7	+2.1	Aztec	91	6	Fort Defiance	8	18	0.00	−0.74		0.00	55 stations	0.00
Arkansas	47.6	−3.0	Amity Lake Village	89 89	13 4	Witt Springs	2	18	0.64	−3.42	Paragould	1.85	Texarkana	0.00
California	55.2	+1.5	Elsinore Ogilby	96 96	26, 27 15	Bodie	5	26	5.03	+2.36	Branscomb	37.17	35 stations	0.00
Colorado	37.1	+2.2	Holly, Lamar, Wray	81	8	Breckenridge	−17	18	0.30	−0.31	Breckenridge	2.29	7 stations	0.00
Florida	62.6	−1.8	Orange City	93	1	Middleburg	17	28	2.66	+0.53	Pensacola	11.46	3 stations	T.
Georgia	51.9	−2.2	Albany	88	2	Diamond	11	27	2.49	−0.33	Blakely	6.85	Naylor	0.30
Idaho	36.3		Bluelakes Garnet	79 79	2 3	Soldier	−18	17	2.81		Murray	7.19	Blackfoot	0.47
Illinois	38.2	−2.0	Centralia	85	4	Lanark	2	27	1.06	−1.63	Cobden	2.22	Carrollton	0.28
Indiana	38.4	−2.9	Winamac	79	2	Valparaiso	2	27	1.82	−1.72	Huntington	3.55	Mount Vernon	0.51
Iowa	34.2	−0.1	Pacific Junction	76	1	Audubon Carroll	−5 −5	26 18	0.52	−0.85	Allerton	1.74	7 stations	T.
Kansas	41.8	−0.1	Viroqua	85	8	Colby	−5	18	0.97	−0.04	Pleasonton	2.28	Pratt	T.
Kentucky	42.5	−3.6	Maysville	81	3	Loretto	5	27	3.01	−0.99	Hopkinsville	4.53	Bowling Green	1.21
Louisiana	56.4	−2.3	Minden	94	13	Collinston	10	19	0.36	−3.54	Hammond, State Experiment Station.	1.35	3 stations	0.00
Maryland and Delaware	41.0	−2.9	Boettcherville, Md.	82	3	Deerpark, Oakland, Md.	1	28	1.19	−2.06	Deerpark, Md.	2.60	2 stations	0.56
Michigan	33.0	−2.2	Chatham	78	1, 3	Humbolt Iron River	−10 −10	25 28	1.89	−0.93	Houghton	5.17	Onaway	0.47
Minnesota	27.3	−0.5	Beardsley Currie	75 75	3 2	Pokegama Falls	−37	26	0.35	−0.50	Mount Iron	1.96	8 stations	T.
Mississippi	51.7	−2.9	Thornton	88	1	Shoccoe	10	27	1.17	−2.07	Columbus	5.51	Louisville	0.00
Missouri	40.9	−2.0	Appleton City Jackson	79 79	8 4	Monroe City, Sublett	2	26	1.24	−1.14	Caruthersville	3.26	Shelbina	0.20
Montana	28.6	−1.5	Culbertson	76	2	Augusta	−39	17	1.29	+0.02	Troy	4.86	Glendive	T.
Nebraska	37.0	+1.2	Halsey	79	7	Agate	−13	18	0.77	+0.11	Edgar	2.74	2 stations	T.
Nevada	41.8	+3.3	Palisades	89	3	Tecoma Wadsworth	4 4	8 26	0.67	−0.04	Lewers Ranch	7.26	7 stations	0.00
New England*	35.3	−1.8	Hartford, Conn.	78	4	Stratford, N. H.	−9	27	2.01	−1.91	Hyannis, Mass.	6.11	Berlin Mills, N. H.	0.77
New Jersey	39.9	−3.4	Paterson	79	4	Layton	3	26	1.26	−2.34	Cape May C. H.	2.03	Canton	0.75
New Mexico	45.2	+2.5	Fruitland	90	23	Winsors	−2	18	T.	−1.62	Eagle Rock Ranch	0.03	26 stations	0.00
New York	34.0	−3.5	Primrose	75	4	Wells	−14	26	2.06	−1.08	Volusia	5.54	Paul Smiths	0.22
North Carolina	46.5	−3.3	Rockingham	87	4	Linville	0	28	1.81	−1.44	Bryson City	4.08	Lumberton	0.35
North Dakota	25.3	+1.0	Mayville	78	3	Pembina	−20	24	0.26	−0.50	Portal	0.90	4 stations	T.
Ohio	37.2	−3.4	Wilson	88	3	Kenton	2	20	2.10	−0.98	Cadiz	4.11	Toledo	1.01
Oklahoma and Indian Territories.	47.1	−1.8	Eldorado, Okla.	92	15	Pawhuska, Okla.	2	18	0.37	−1.99	Tulsa, Ind. T.	1.36	7 stations	0.00
Oregon	43.4	+0.4	Dayville	80	1	Wallowa	2	17	9.87	+3.28	Glenora	24.58	Umatilla	2.02
Pennsylvania	36.9	−3.3	York	78	4	Saegerstown	0	29, 30	2.18	−1.37	St. Marys	5.33	Harrisburg	0.88
Porto Rico	76.1		Adjuntas	97	17	Adjuntas Cidra	54 54	23 7	8.07		La Carmalita b	19.12	Bayamon	2.04
South Carolina	50.9	−3.3	Bennettsville	86	5	Clemson College	10	27	1.40	+1.28	Batesburg	3.17	Georgetown	T.
South Dakota	30.8	+0.4	Ashcroft	80	7	Ashcroft Forestburg Redfield	−10 −10 −10	18 26 19	0.39	−0.12	Elk Point	1.57	2 stations	T.
Tennessee	45.3	−2.7	Liberty	85	2	Rugby Silver Lake	4 3	27 28	4.00	+0.36	Grace	8.20	Pope	2.55
Texas	57.3	−0.8	Georgetown Tilden	97 97	13 13, 14	Tulia	8	18	0.17	−2.48	Huntsville	1.44	57 stations	0.00
Utah	39.1	+0.9	Thistle	80	1	Henefer	−19	17	0.73	−0.03	Millville	3.34	19 stations	0.00
Virginia	42.8	−4.5	Bedford City Lexington, Spottsville (near).	80 80	2 4	Burkes Garden Hot Springs	0 0	28 30	1.74	−0.93	Marion	3.95	McDowell	0.13
Washington	40.0	−0.2	Dayton	79	1	Republic	−7	17	6.31	+1.45	Clearwater	24.84	Ephrata	1.41
West Virginia	38.0	−4.5	Charleston	80	16	Travellers Repose	−5	28	2.46	−0.62	Pickens	4.98	Upper Tract	0.67
Wisconsin	30.0	−1.7	Koepenick Oshkosh Prairie du Chien	75 75 75	3 9 1	Osceola	−15	15	0.95	−0.70	Sheboygan	1.79	La Crosse	0.04
Wyoming	32.1	+1.3	Pinebluff	78	7	Border, Daniel	−29	18	0.94	−0.12	Battle	6.20	Fort Washakie	0.00

* Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, and Connecticut.

North Carolina.—The early portion of the month was favorable for farming operations and considerable winter oats and wheat was sown. Moderate precipitation and temperatures above normal favored the growth of early sown grain. The deficiency in moisture and severe cold during the latter part of the month prevented rapid germination and the further growth of wheat. At the close of the month early sown wheat looked fairly well, but most of the late sown was not up. There were some complaints of damage by Hessian fly. Full average areas of winter wheat, oats, and rye will be sown, but the work was not completed.—*C. F. von Herrmann.*

North Dakota.—The weather was very favorable for stock on the ranges, the grass being good and not covered with snow, so that feeding was not necessary during the month. No farm work was done as the ground was frozen.—*B. H. Bronson.*

Ohio.—The first of the month was too dry for wheat in the central and southern sections, but the crop continued in good condition in the north, and at the close of the month was well protected by snow in all sections. Corn cured well, and husking progressed fairly well. Water continued low in the south.—*J. Warren Smith.*

Oklahoma and Indian Territories.—Drought conditions were injurious to growing wheat and rye; early wheat did well, but late did not sprout over the western counties, and much was reported dead or damaged; some early wheat was pastured, but generally pasturage was cut short, an increased acreage reported; bulk of cotton crop secured, with poor to fair yields; spring plowing progressed; late potatoes poor yield; stock did well, but was largely fed.—*C. M. Strong.*

Oregon.—The weather during November was very rainy, but the temperature was mild, and no severe cold weather occurred. The rain prevented work in the field, and but little wheat was sown, especially in the Willamette Valley and southern Oregon. The mild weather was favora-

ble to grain already in the ground, and that sown in September and October germinated nicely, generally came up to good stands, and maintained a slow and steady growth. At the close of the month it was everywhere reported to be in excellent condition.—*A. B. Wollaber.*

Pennsylvania.—At the close of the month the soil was in good condition in practically all sections and frozen sufficiently deep to cause a suspension of plowing; wheat and rye ranged from medium to very good, but were generally short on account of late seeding; considerable corn remained uncut; there was but little snow in any district for the protection of grain or grass.—*T. F. Townsend.*

Porto Rico.—Heavy thunderstorms and high winds on the 23d and 24th did some damage to fruits and small crops in some localities, but, in general, the weather was favorable for growing crops and for fieldwork. The older canes commenced to arrow freely in the drier sections of the island early in the month, and near the close a few mills had begun grinding. The outlook for a good yield was very promising. The young canes were in excellent condition. Coffee picking progressed rapidly during the first half of the month under very favorable weather conditions, and at the end of the month this work was nearing completion. Several small plots of cotton were picked, and where the crop had proper care the return was very satisfactory. Some rice and corn were harvested, while other plots were in the blossoming stage. Orange shipping was active. Pastures and stock continued in excellent condition.—*E. C. Thompson.*

South Carolina.—The first six days and the middle of the second decade were warm; the rest of the month was unusually cold, with killing frost on the 7th and 8th and the first ground freeze on the 18th and 19th, after which the month remained cold, with frequent frosts and ground freezes. The precipitation was light, but evenly distributed. Oats seeding was nearly finished, but germination was slow and stands small. Wheat seeding made slow progress, and but little of that sown came up to stands. Many bolls of late cotton were destroyed in the western counties by frosts and low temperatures. The crop was picked closer than usual and picking was practically finished. The cold weather injured fall and winter truck, but was favorable for butchering hogs, making a saving of nearly one month of feeding.—*J. W. Bauer.*

South Dakota.—There was considerable cold weather after the 14th, and snows interfered locally to some extent with field farm work, but the conditions were, on the whole, favorable. There was, however, considerable corn yet in the field in the Sioux River Valley at the close of the month. Thrashing was about finished. Winter rye and the very limited amount of winter wheat sown were protected by snow during the cold weather and kept in satisfactory condition.—*S. W. Glenn.*

Tennessee.—Conditions were generally favorable for gathering crops and seeding grain. Good rains fell about the first and middle of the month; otherwise it was rather dry. The second half of the month was cold. Early sown wheat was generally looking well, but much of the crop was sown late and made slow progress; the acreage is much less than last year; there was some injury by freezes. Rye and oats were doing fairly well. Spring clover was injured by the fall drought. Corn and cotton were mostly gathered.—*H. C. Bate.*

Texas.—The month was the driest November on record. Decided falls in temperature occurred on the 18th and 19th and the 27th and 28th, giving freezing temperatures to the coast region. Conditions were exceptionally favorable for the picking of cotton. About one-eight of the crop is still in the fields in the north portion, but elsewhere the crop is practically all picked. The freeze of the 18th and 19th killed the cotton plants, but, as there was little or no top crop, this caused very slight damage. Wheat, rye, and oats that were up at the beginning of the month continued in fair condition, but needed rain. The dry condition of the soil greatly retarded plowing and sowing. No damage was done to the sugar cane crop by the cold weather. Cutting and grinding progressed rapidly with very satisfactory results. Fall gardens, pastures, and the ranges were in need of rain.—*L. H. Murdock.*

Utah.—Temperatures during the month were generally above normal, excepting during the latter part of the second decade, when abnormally cold weather prevailed. Precipitation was above normal over the northern half of the section, placing the soil in good condition and favoring rapid germination and growth of fall grain, which was coming up to good stands over the southern half, where, however, but little fall grain was sown; scarcely any precipitation fell and the ground was dry and hard. Stock and ranges were in good condition.—*R. J. Hyatt.*

Virginia.—Crop progress during the month was much retarded by weather conditions that were both colder and drier than normally. Early sown winter grain was not materially injured on account of its more advanced stage of growth, but the late seeding of wheat, oats, rye, and clover was damaged, especially on wet soils.—*Edward A. Evans.*

Washington.—The month was one of heavy rainfall in the western section and an unusual amount of rain and snow fell in eastern section. The first decade was warm, the second decade cold with heavy frost and considerable snow, while the third decade was moderately warm. On account of much stormy weather, the month was unfavorable for farm work, but it was beneficial to the growth of fall sown wheat. Late crops were mostly gathered in all districts.—*G. N. Salisbury.*

West Virginia.—The dry weather, followed by the freezing temperatures with no snow protection during the latter half of the month, was very unfavorable for the growth of winter wheat, rye, and oats, and at the close of the month they were in poor condition. The acreage of wheat sown was not as large as usual. Stock was generally in good condition and feeding began earlier than usual. Some corn was still in shock, and the prospects were for a better crop than had been expected. It was too dry for turnips.—*E. C. Vose.*

Wisconsin.—The month was generally fair and pleasant during the first ten days with temperatures above normal, but from the 12th to the end of the month, decidedly cold weather for the season prevailed. Moderately heavy rains occurred on the 11th, turning to snow. Snow occurred again on the 17th, 23d, and 28th, and ranged in depth at the end of the month from two to ten inches. Winter grains and grasses were amply protected by the snow, and were reported in good condition.—*W. M. Wilson.*

Wyoming.—Uunusually pleasant weather with mild temperatures prevailed over the State during the first and last two weeks of the month A cold wave on the 17th and 18th was general, but was not severe on stock. Practically all of the precipitation of the month fell during the stormy period from the 7th to the 17th of the month.—*W. S. Palmer.*

SPECIAL CONTRIBUTIONS.

STUDIES ON THE CIRCULATION OF THE ATMOSPHERES OF THE SUN AND OF THE EARTH.

By Prof. FRANK H. BIGELOW.

II.—SYNCHRONISM OF THE VARIATIONS OF THE SOLAR PROMINENCES WITH THE TERRESTRIAL BAROMETRIC PRESSURES AND THE TEMPERATURES.

SEVERAL OPINIONS ON THE SUBJECT OF SYNCHRONISM.

The numerous studies during the past fifty years into the apparent synchronism between the solar variations of energy and the terrestrial effects, as shown in the magnetic field and the meteorological elements, have been on the whole unsatisfactory, if not disappointing. Just enough simultaneous variation has been detected in the atmospheres of the sun and the earth to fascinate the attentive student, if not to justify a large expenditure of labor, in view of the great practical advantages to be obtained in the future as the result of a complete understanding of this cosmical pulsation. The attack upon the problem has really consisted in rather blindly groping for the most sensitive pulse in the entire cosmical circulation, and in disentangling the several interacting types of impulses. It is evident that the partial failures hitherto attending this work have been due to two principal causes: (1) The comparison was made between the changes in the spotted areas of the sun and the terrestrial variations, but these solar changes were not sensitive enough to register a complete account of the action of the solar output. Discussions of the spots are being replaced by others upon the solar prominences and faculæ, which respond much more exactly to the working of the sun's internal circulation. (2) The magnetic and the meteorological observations have not been handled with sufficient precision to do justice to the terrestrial side of the comparison. It is evident that all these physical data at the sun and at the earth must be computed with an exactness comparable to that of astronomical observations of position, if meteorology is to be raised to the rank of a cosmical science. When one considers the crudeness of the meteorological data, taken the world over, due to the character of the instruments employed, the different local hours of observation, and the divergent methods of reduction, it is no wonder that the small solar variations have been swallowed up in the bad workmanship of meteorologists. The prevailing methods have been sufficient for forecasting and for climatological purposes, but they are entirely inadequate for the cosmical problems whose solution will form the basis of scientific long-range forecasts over large areas of the earth, that is, for forecasting the seasonal changes of the weather from year to year. It is perfectly evident that if secular variations of any kind, such as the annual changes in terrestrial pressure, temperature, or magnetic field, are to be attributed to solar action, the original observations must be finally reduced to a homogeneous system. The local peculiarities of each station

must be carefully eliminated, and the data of numerous stations must be concentrated before anything like quantitative cosmical residuals can be obtained. When we consider that there have been numerous changes in the elevations of barometers, various methods of reducing the readings, and many groups of selected hours of observations entering into the series at the same station, how could it be expected that any thing better than negative results in solar problems would be obtained? The skeptical attitude of conservative students, who declare that the many indecisive results already obtained mean that there is no true and causal solar-terrestrial synchronism, is, of course, quite fallacious until it has been demonstrated by the use of first-class homogeneous data that the suspected physical connection is imaginary. There is but little question that the existing uncertainty is in fact based upon the use of the very imperfect methods of observation and reduction which have prevailed in meteorological offices, rather than upon the unreality of the phenomena in nature. At present the difficulties of the research are diminishing by reason of two improvements; (1) a better knowledge of where to make the comparison, and (2) the gradual acquisition of reliable secular data. Thus, the prominence data are superseding the sun-spot numbers, and it has now become comparatively easy to traverse the magnetic and the meteorological fields with our improved standard curve of comparison, and to bring out the fundamental typical synchronism in nearly every series of observations, so far as the annual means are concerned.

The importance of emancipating this subject from the prevailing skepticism is evidently in the interests of advancing cosmical science. If we can prove that other forces than the Newtonian gravitation and radiation are interacting between the sun and the earth, it becomes a conclusion of vital interest to astronomers. As an example of the present state of opinion, we note Prof. Simon Newcomb's address[17] before the Astronomical and Astrophysical Society of America on December 29, 1902, in which he says:

> The conclusion is that spots on the sun and magnetic storms are due to the same cause. This cause can not be any change in the ordinary radiation of the sun, because the best records of the temperature show that, to whatever variations the sun's radiation may be subjected, they do not change in the period of the sun spots.

We shall, on the other hand, show in this paper that terrestrial temperatures do, as a whole, change with the variations of the solar prominences, and this will tend to modify Professor Newcomb's inference. The question whether the connection is direct or indirect, by a magnetic field or by some special action of radiation, is to be decided finally by an appeal to the observations. Dr. J. Hann writes in his Lehrbuch der Meteorologie, pages 626, 627:

> These can lead to the discovery of the period, but it is very difficult to find the true length of the period, since the amplitude of the variation of the meteorological elements within the period is not very great, because so many other influences are present, which stand in the way of deriving more accurate mean values out of long intervals of time. As yet no one has succeeded in surely deducing for any one meteorological element a cyclic variation of considerable amplitude.

These efforts have been applied to variations of temperature, clouds, rainfall, thunderstorms, hail, barometric pressures, cyclones, and winds, especially with the view of finding an 11-year period synchronous with that of the sun spots. It should be noted that a shorter period, of about three years, is probably the better period of synchronism to be studied. Also, synchronous movements need not be truly periodic. Indeed, there may be true correspondence with very irregular and aperiodic changes. It is easier to connect loosely constructed variations in the prominences of about three or four years duration with terrestrial variations than to establish synchronism in the 11-year sun-spot period. Dr. A. Sprung, in his Lehrbuch der Meteorologie, pages 366, 367, writes:

> Therefore, a connection between the sun-spot frequency and the changes in our atmosphere can not well be denied. It is probable that the periodic changes in the atmosphere are not caused directly through the sun spots, but that both phenomena are brought about through one common or by several interacting causes, whereby a displacement of the periods relative to one another becomes possible.

Prof. Cleveland Abbe has frequently expressed in the MONTHLY WEATHER REVIEW a very doubtful view regarding the advisability of such researches, with the object of discouraging further efforts to unravel the solar-terrestrial net. Thus, in the MONTHLY WEATHER REVIEW for June, 1901, page 264, he writes:

> As the periodicities in sun spots, the width of the spectrum lines, the magnetic and auroral phenomena are sufficiently well marked to be satisfactorily demonstrable, while corresponding variations in pressure, temperature, wind, and rainfall are small, elusive, and debatable, we must caution our readers against being carried away by optimistic promises. It is certainly impressive to the thoughtful mind to realize that there is even a slight connection between solar and terrestrial phenomena, but the delicacy of this connection is such that it still remains true that the study of meteorology is essentially the study of the earth's atmosphere as acted upon by a *constant source of heat* from the sun. None of these astrophysical studies should tempt the meteorologist to wander far from the study of the dynamics of the earth's atmosphere and the effects of the oceans and continents that diversify the earth's surface.

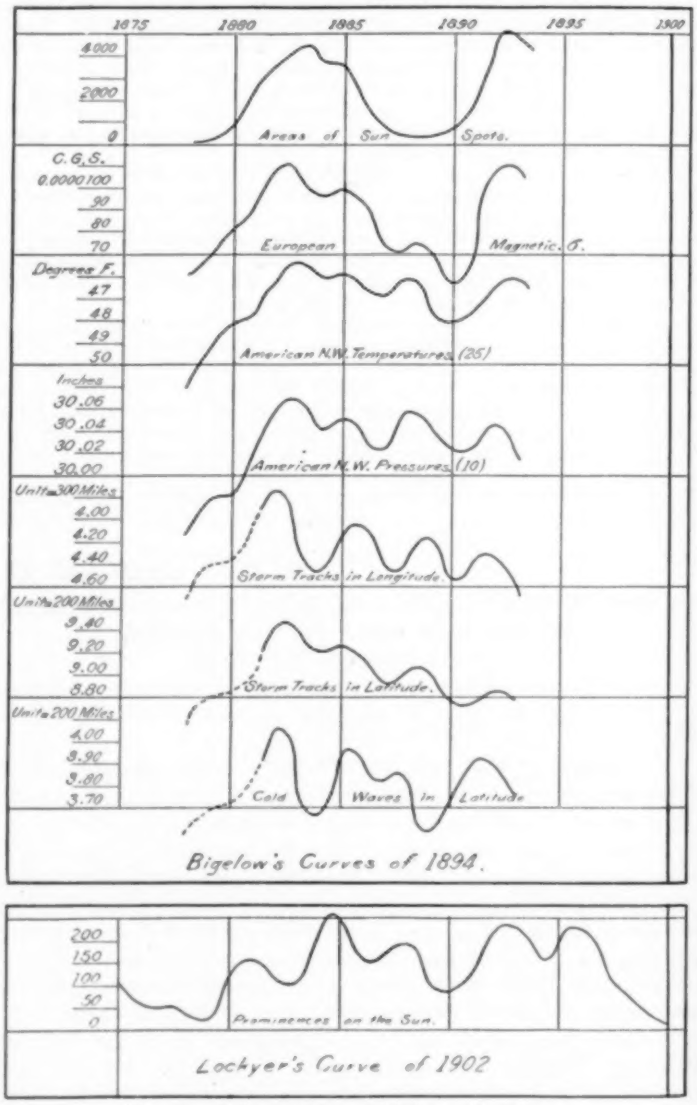


FIG. 5.—Solar and terrestrial synchronism.

We have, nevertheless, merely to recall the works of many scientists in order to realize how strong a hold this problem has upon the astrophysical meteorologist: Herschel, 1800; Gautier, 1844; Fritsch, 1854; Arago, 1855; Zimmermann, 1856; Wolf, 1859; Meldrum, 1870; Koeppen, 1873; Hill, 1880;

[17] Science, January 23, 1903.

van Bebber, 1882; Blanford, 1889; Bruckner, 1890; Lockyer, 1898; Carrington, Spoerer, Wolfer, and many others. The number of students who are taking up the problems of cosmical meteorology is rapidly increasing, and this shows that there is encouragement for such work.

The present paper continues the discussion of an investigation first published in 1894,[18] which brought out the fact that there is a synchronous variation in short cycles of about three years duration superposed upon the 11-year sun-spot period. In Bulletin No. 21, Solar and Terrestrial Magnetism, page 127, it was said:

> A comparison of the mean American meteorological curve with the European magnetic curve certainly shows conformity to such an extent as to exclude merely accidental physical relations. Should such a result be obtained also in the future, it will be a demonstration of the synchronism of the two systems of forces under consideration.

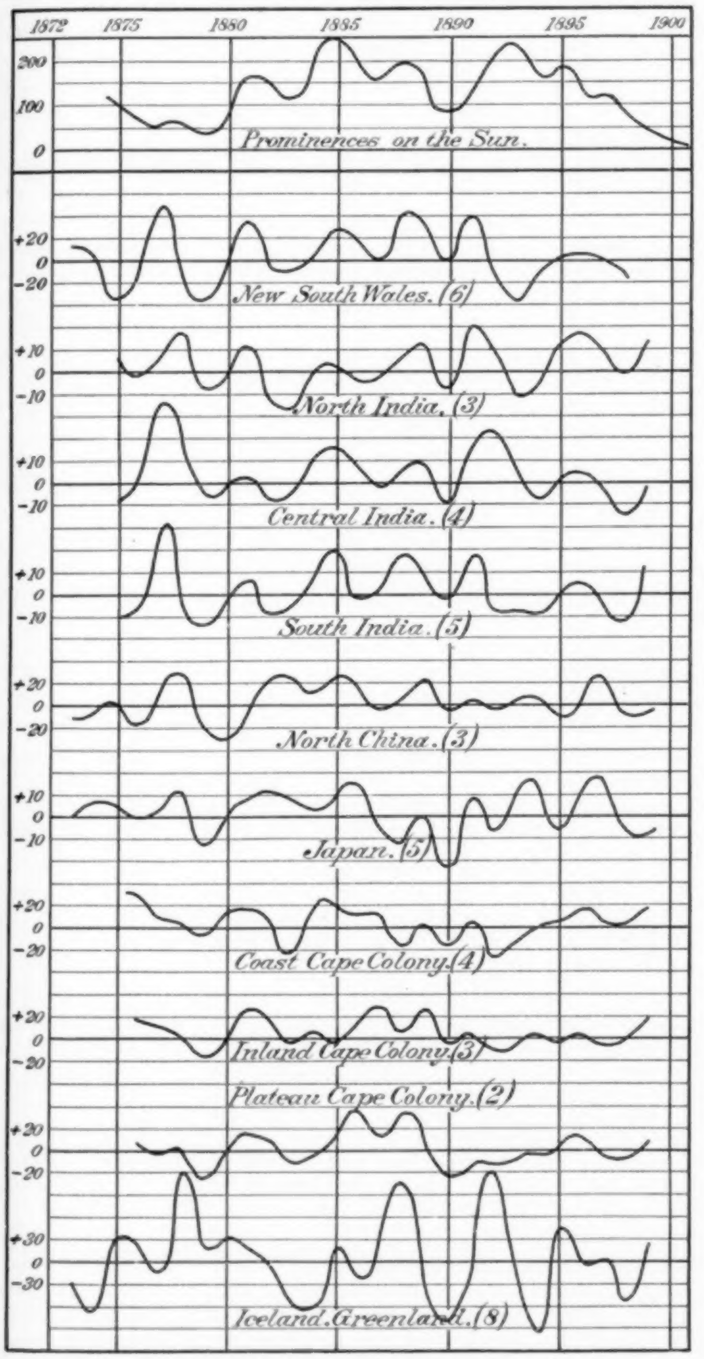


FIG. 6.—Variations of the annual pressure in the direct type.

[18] Inversion of Temperature in the 26.68-day Solar Magnetic Period. Amer. Journal of Science. Vol. XLVIII. December, 1894.

Since that time advances have been made as follows:

The magnetic curve has been extended from 1841 to 1900; the barometric pressures of the United States have been reduced to a homogeneous system; the curves of prominence frequency on the sun have been computed by Lockyer and independently by myself; the variations of the prominences have been closely associated with the changes in the angular velocity of the solar surface rotations in different zones, especially in the polar latitudes; the type of internal circulation necessary to produce this polar retardation, and to transform the solar mass into a polarized magnetic sphere, has been indicated.

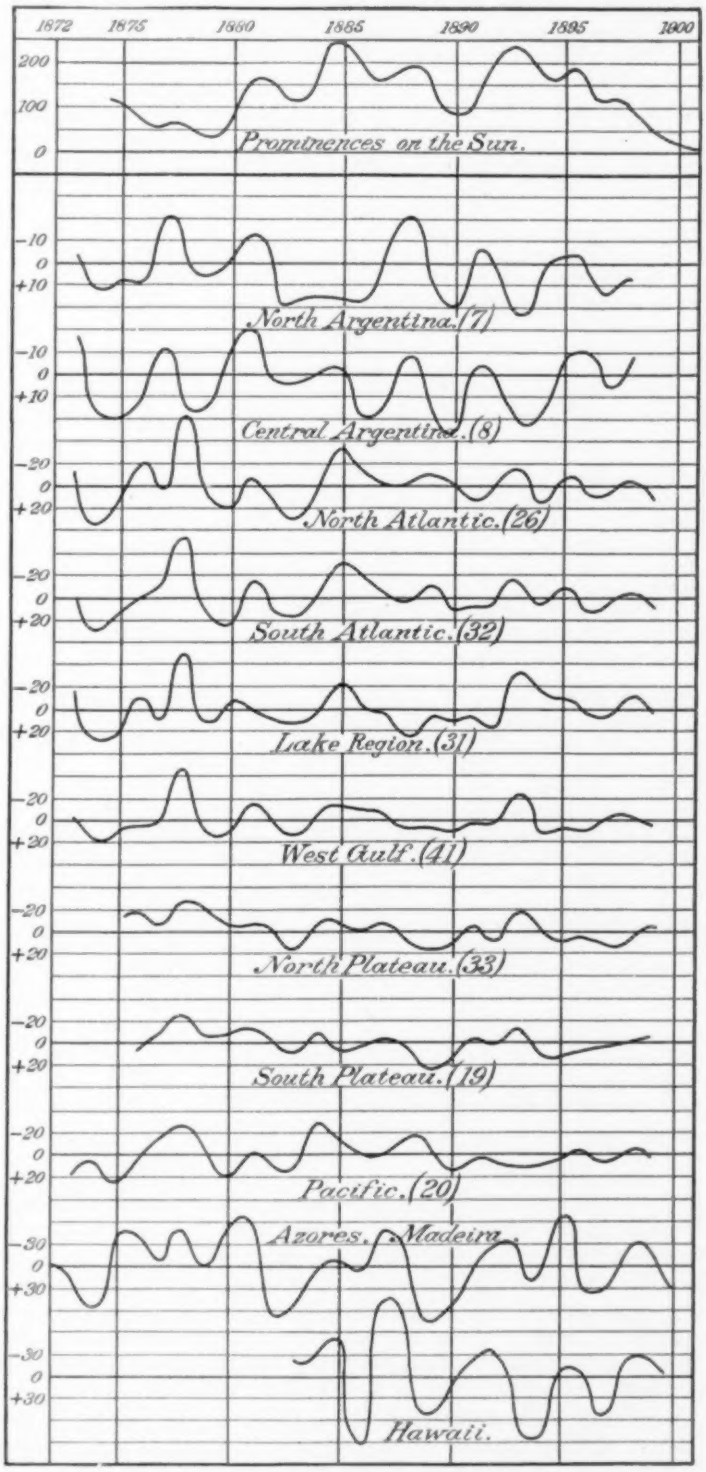


FIG. 7.—Variations of the annual pressure in the inverse type.

In the present paper we shall show the results of a discussion of the annual residuals of pressure and temperature in all parts

of the earth. These have a variation in *direct* synchronism with the prominences, in certain parts of the earth, but under special conditions of orography the synchronism is of the *inverse* type. This chain of evidence is strong enough to induce confidence in regard to the fact that this solar-terrestrial physical synchronism really exists.

THE UNSATISFACTORY STATE OF THE OBSERVATIONAL DATA.

The two prevailing difficulties in extracting suitable data from the published reports of meteorological observatories, and reducing them to a homogeneous system, are the numerous changes in the elevation of the barometers, and in the very different hours of making the observations. Without the expenditure of labor entirely beyond the capacity of a single office to bestow upon the task, when the research for synchronism is extended to the entire earth, it has been necessary to

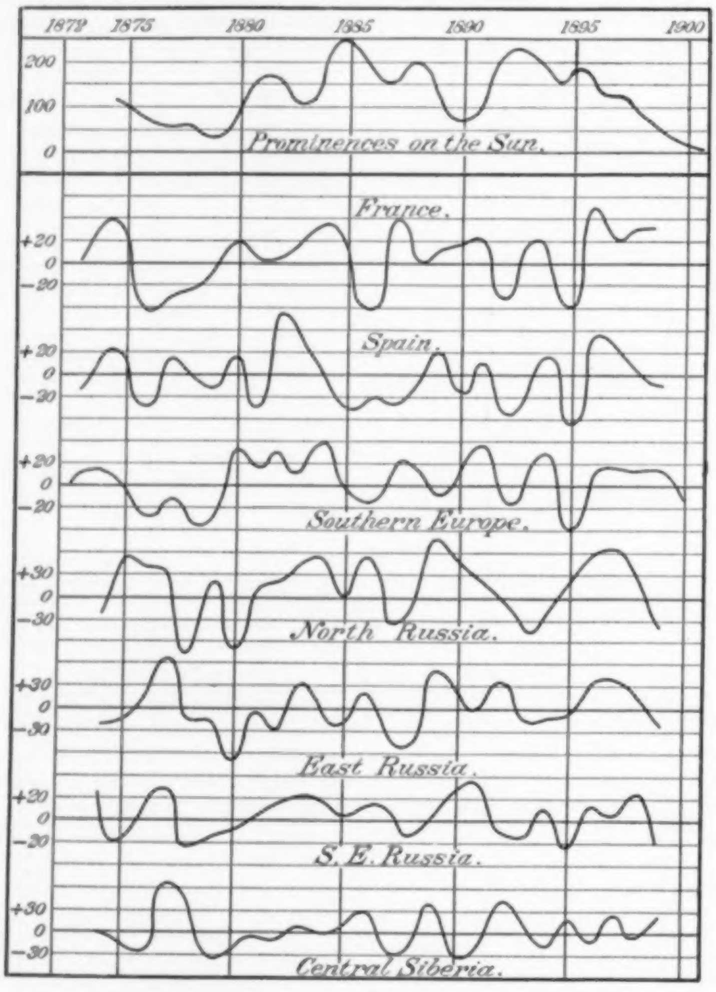


FIG. 8.—Variations of the annual pressure in the indifferent type.

use some simple devices for the sake of arriving at approximately homogeneous residuals. The work for the United States is complete for the pressures, and is in progress for the temperatures. By inspecting my Barometry Report[19] it is easy to see the reason for the necessity of the reduction. In order to give some idea of the state of the data in other countries, we note the following with respect to the barometric pressures:

For Russia-Siberia, several stations changed elevation more than once.

India, there are numerous changes of elevation.

South Africa, numerous changes of elevation, and also of the hours of observation.

New South Wales, the monthly means of observations alone were published. These had to be collected before the annual means could be computed.

Argentina, the monthly means of observations alone were published, and these also had to be collected before the annual means could be computed. The stations have quite short records.

Iceland and Greenland, very few changes in elevation, but not long records.

In general all the annual pressure curves were plotted, and a mean pressure and normal gradient were determined, from which the amplitude variations were taken off as residuals. Since our purpose was simply to secure the most probable annual residuals this graphic method was substituted for the exact computations which ought to be made. Frequently the secular gradient slope was so prominent throughout the series for a single station as to suggest a gradual change in the correction of the barometer relative to a normal standard.

With respect to the temperatures, the annual means were extracted from the reports, and the mean values for the several series were computed, so far as they were apparently homogeneous, and from these the residuals were formed. As the cosmical annual variation of temperature is only 1° to 2° F., it was often possible to break up a long series at the same station into homogeneous sections; but this was done cautiously, and only after clear evidence of a discontinuity in the local conditions. The great difficulty with the temperature data consists in the numerous hours of observation that have been adopted, or in the numerous selected groups of hours from which the means were derived. Many of these differences arose from artificial attempts to obtain an approximately correct 24-hour mean, to which in fact all meteorological data should be very carefully reduced. Some of the combinations of hours used are as follows:

United States, Washington mean time, 7:35, 4:35, 11:35; 7:35, 4:35, 11:00; 7, 3, 11. Seventy-fifth meridian time, 7, 3, 11; 7, 3, 10; 8, 8; maximum, minimum.

New South Wales, 9 a. m.; 9, 3, 9; maximum, minimum.

South Australia, 9, 3, 9; 9, 12, 3, 6, 9; maximum, minimum.

West Australia, 9, 3; 9, 12, 3; 9 a. m.; 6, 6; maximum, minimum.

Ocean Islands, hourly; 9, 3, 9, minimum; 6, 9, 1, 3, 3:58.

Japan, 9:30, 3:30, 9:30; 4-hourly, or 2, 6, 10, 2, 6, 10.

China, hourly; 10, 4, 10.

India, 8, 10, 4; 10, 4; 6-hourly, or 10, 4, 10, 4; 9:30, 3:30; 9, 4; 10:30, 3:30; maximum, minimum.

Russia-Siberia, 7, 1, 9; 7, 2, 9; 9, 12, 9; 8, 1, 9; hourly.

Europe, 7, 2, 9, 9; 7:45, 8; 6, 2, 10; 3-hourly; maximum, minimum; 7, 10, 1; 4, 7, 11; 7, 1, 7; 6, 9, 12; 3, 6, 9; 6, 12, 9; hourly.

Azores-Madeira, 9, 3, 9.

North Africa, 7, 2, 9; 7, 11, 2, 5; 7, 1, 6; 9, 3, 9.

South Africa, 6, 12, 6; 6, 2; 9, 9; 8, 8; 8 a. m.

South America, 7, 2, 9; hourly.

Iceland-Greenland, 8, 2, 9.

From such an exhibit it is no wonder that meteorology has not yet contributed its proper share to accurate cosmical physics. It is needless to recount the reason for this state of affairs, but only to urge as speedy a remedy as is possible. It might be argued that no results can be derived from such data; but this is not true, as a study of the residuals summarized in this paper amply confirms. It is, perhaps, surprising that valuable results can be extracted from the data, and this only proves how important such work might be made if sufficient care were exercised in selecting the hours of observation, and establishing rigorous methods of reduction. It frequently happens that at a given station the same hours continue to be used for many years, so that in effect its own residuals are nearly homogeneous. The means of the various combinations of selected hours generally approximate a true 24-hour mean, so that on the whole there is something like homogeneity in the differ-

[19] Report of the Chief of the Weather Bureau, 1900-1901, Vol. II.

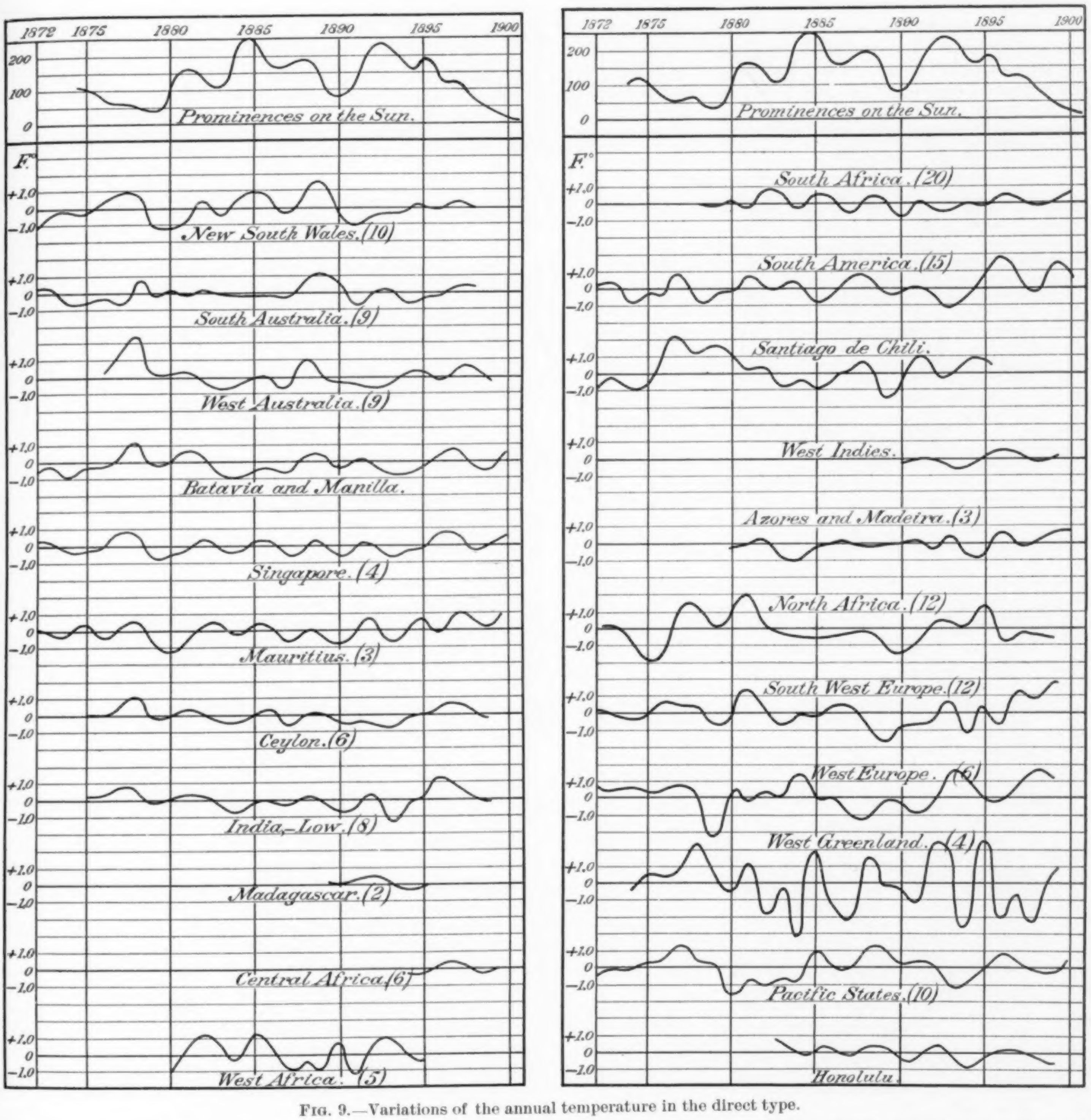


FIG. 9.—Variations of the annual temperature in the direct type.

ent changes. The fact that residuals synchronous with solar variations actually survive, is a satisfactory evidence that the causes producing them are solar and not local terrestrial.

It is not possible to print in the MONTHLY WEATHER REVIEW the table of residuals for each station, and we must confine ourselves to the curves representing the mean residuals for a group of stations, the number being entered in connection with the name of the country. Thus, for New South Wales the pressure curve, fig. 6, was determined from six stations, Albany, Bathurst, Deniliquin, Goulborn, Newcastle, Sydney.

RESULTS OF THE OBSERVATIONS.

The argument for solar and terrestrial synchronism may be recapitulated as follows:

Bigelow's curves for 1894 showed a synchronism in a short period of about three years, superposed upon the 11-year sun-spot curve, for the following elements: Terrestrial magnetic field, American temperatures, pressures, storm tracks in longitude and latitude, and cold waves in latitude. In 1902 Lockyer worked out the annual variation in the solar prominences and arrived at the same system of minor crests in the sun that had previously been determined at the earth. These curves are shown on fig. 5, "Solar and terrestrial synchronism."

A study of the temperature and the pressure residuals for the entire earth shows that the phenomena of inversion prevails in the earth's atmosphere, localizing the effect of solar action in two typical curves which are the inverse of one another. I have previously found a form of inversion of en-

ergy in the terrestrial magnetic field, and efforts have been made to explain the phenomenon. Besides the secular inversion here illustrated, I have found a semiannual inversion in the meteorological elements of the United States, as stated in other places, and much work has been done in developing this important fact.

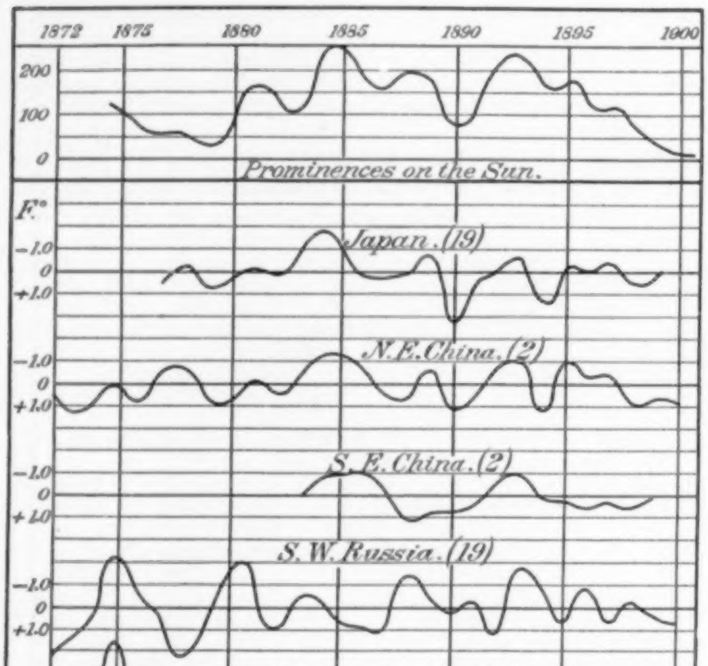


FIG. 10.—Variations of the annual temperature in the inverse type.

We have treated the secular inversion as follows: The curves of the mean residuals of the pressures and temperatures, taken by geographical groups as indicated, were plotted to scale and compared with the Lockyer solar prominence curve as to the recurrence of the successive maxima and minima. They were then associated in three groups, as follows:

I. Direct type, wherein the solar and the terrestrial maxima closely match each other throughout the interval 1873–1900.

II. Inverse type, wherein the terrestrial curves must be inverted to make the maxima coincide.

III. Indifferent type, wherein there is not sufficient evidence of conformity with the type curve to be satisfactory.

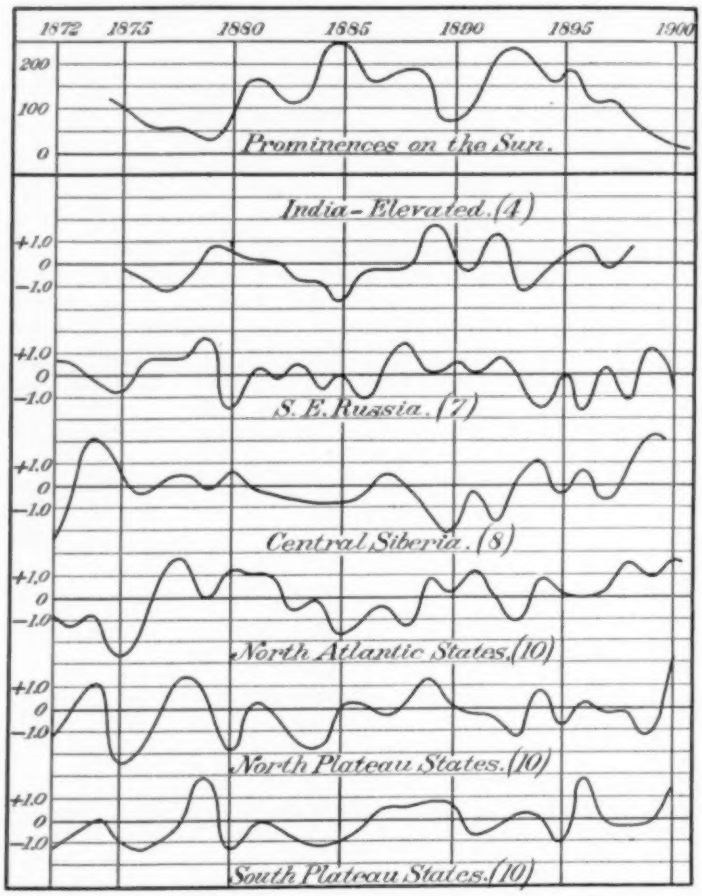


FIG. 11.—Variations of the annual temperature in the indifferent type.

There may be differences of opinion as to the assignment of some of these curves, but the reader can make any different arrangement that he prefers. It seems to me that the general fact of synchronism is so pronounced as to call for the careful consideration of meteorologists. Fig. 6, "Variations of the annual pressure in the direct type;" fig. 7, in the "inverse type;" fig. 8, "indifferent type;" fig. 9, "Variations of the annual temperature in the direct type;" fig. 10, in the "inverse type;" and fig. 11, in the "indifferent type," are sufficiently explicit without further explanation. The unit for the pressure variation is 0.001 inch, and that for the temperature is 1.0° F. The average range in annual pressure amplitude amounts to as much as 0.060 inch and that for the temperature to 2° or 3° F, more or less.

DISCUSSION OF THE LOCAL INVERSIONS.

These suggestive curves deserve more discussion than is possible in this connection, but fuller data and further remarks will be found in a forthcoming report, which will contain the original data in full. It may be desirable to call attention to the geographical distribution of the types of synchronism thus indicated, by plotting on world charts *D*, *I*, and #, respectively, for the direct, inverse, and indifferent types. Fig. 12, "Distribution of the pressure types," shows that, taking the earth broadly, the region around the Indian Ocean gives direct synchronism, South America and North America give inverse synchronism, while Europe and Siberia give an indifferent type. Greenland and Iceland seem to have direct type

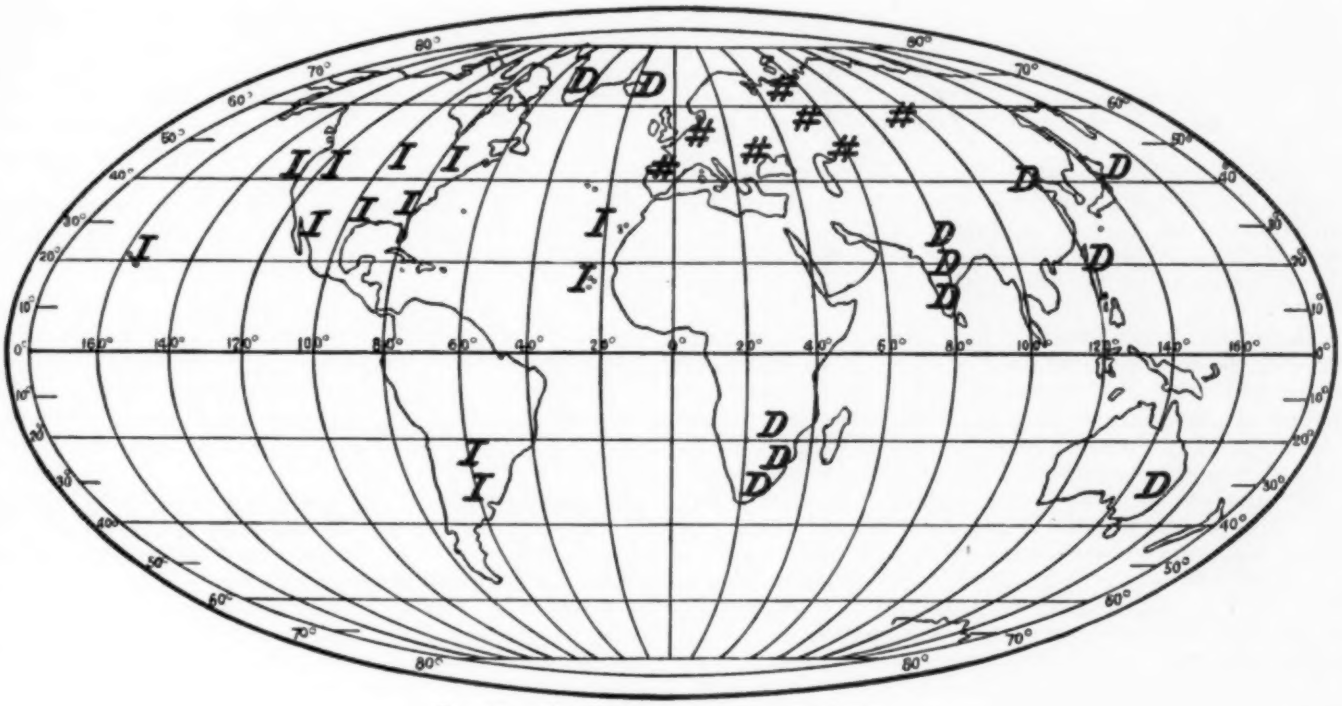


FIG. 12.—Distribution of the pressure types.

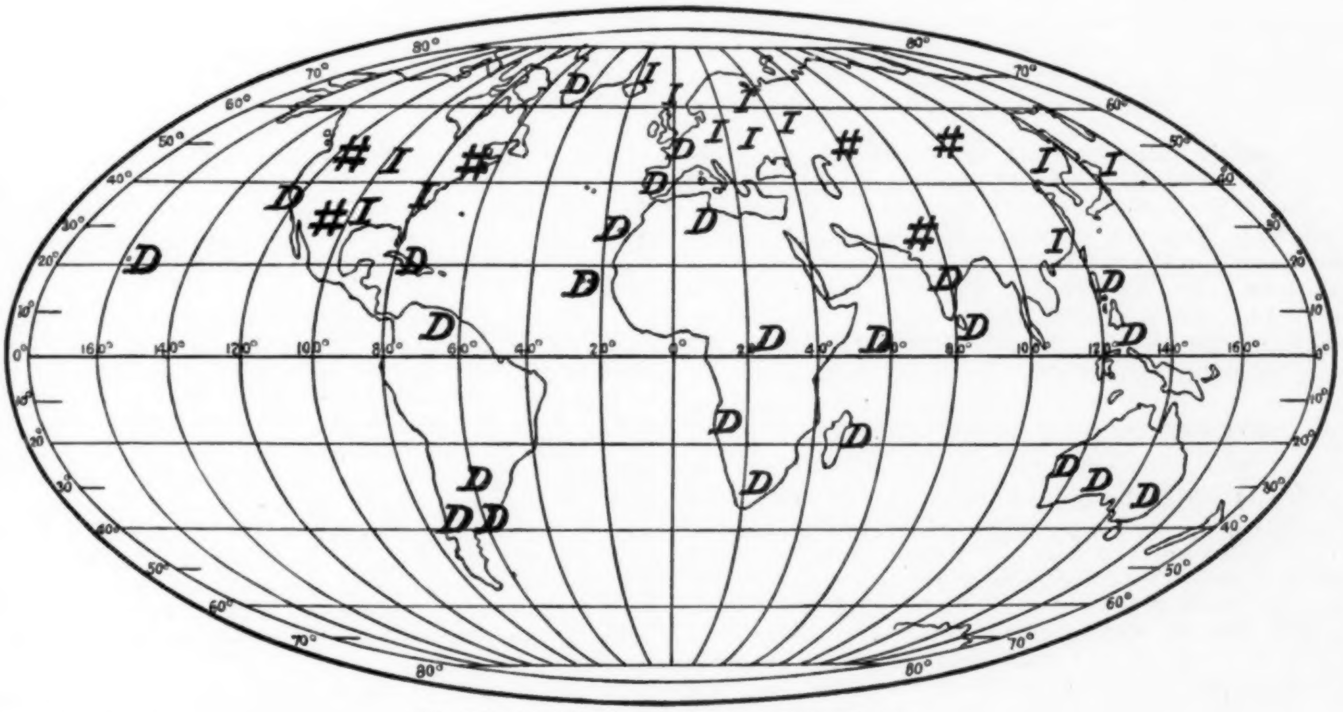


FIG. 13.—Distribution of the temperature types.

like the Indian Ocean. Fig. 13, "Distribution of the temperature types," shows that there is synchronism of the direct type for the Indian Ocean, Africa, South America, the West Indies, and the Pacific islands generally—that is to say, throughout the Tropical Zone. The inverse or the indifferent types prevail in Asia, Europe, and North America generally—that is, throughout the North Temperate Zone.

Taking the earth as a whole, the temperatures synchronize directly with the solar energy in the Tropical Zone, and inversely in the temperate zones. The indifferent type prevails in the plateau districts of the continental areas, probably because the solar type is there so broken up by the local climatic conditions as to practically obscure the synchronism. In the pressures the Eastern Hemisphere tends to direct synchronism, except in Europe and Russia, where the indifferent type prevails, and the Western Hemisphere to the inverse type. It may not be practicable to explain all that this means, but apparently we are dealing with the complication caused by superposing an atmosphere in circulation upon the unequally heated surface of the earth. The surging of the atmosphere as a whole from one hemisphere to the other, or from the continents to the oceans, is concerned in producing these effects. The trend of the great mountain systems strongly differentiates the circulation of the lower strata. Thus, the Himalaya Mountains, running east and west, check the flow of air from the Tropics to the Asiatic Continent, while the Rocky Mountains and the

Andes system favor the flow along the meridians, especially in the United States. As a result, the number of cyclones crossing the United States is many times the number crossing Siberia, which is in fact singularly deficient in cyclones. South America shows a similar defect in circulation, because it lies too near the Tropical Zone.

The United States is covered by an active circulation between the Tropics and the north Polar regions, Siberia by a stagnant atmosphere, and Europe generally by a mixed and indifferent circulation, since the American cyclones tend to break up upon the territory of Europe after crossing the Atlantic Ocean. Hence, the region about the Indian Ocean is favorable for detecting direct synchronisms of pressure and temperature with the solar prominences by reason of its quiescent atmosphere, and the United States is well placed to respond to an inverse synchronism, by reason of its active circulation with a pronounced component from the north Polar regions. Europe does not possess an atmosphere which registers the solar and terrestrial synchronism in a very efficient manner. This may account for the fact that the European attempts to establish a definite synchronism have issued generally with negative results. As has already been suggested, too much emphasis has been put upon the failures to make out the connection between the solar and the terrestrial synchronisms.

It should be noted that C. Nordmann[20] and A. Angot[21] deduced for certain tropical stations small residuals of temperature which are *inverse* to the sun-spot curve, but apparently synchronous. These authors have smoothed their curves by grouping successive years, and have reached small residuals. Since the synchronism should display the annual variations intact, as given above, it may be questioned whether any process for eliminating the minor deflections from year to year is desirable.

We also note the important fact that the wide amplitudes which are characteristic of the 11-year sun-spot curve, and which it has been chiefly sought to discover in the meteorological elements, does not, according to this research, appear at all prominently in the residuals. It is only the short period of about three years that displays the solar terrestrial synchronism. I am not, at present, able to indicate what this result implies in solar physics, but it certainly carries with it a change in our method of approaching the entire problem.

THE PROBLEM OF THE CYCLONE.

By F. J. B. CORDEIRO, dated Newport, R. I., September 5, 1902.[1]

It was Lord Kelvin who showed that a mass of fluid in vortex motion acquires all the properties of a solid, the chief of which are rigidity and elasticity. It was on this demonstration that he founded his astonishing vortex theory of matter. He showed perfectly that an atom of matter might possibly be nothing else than the frictionless fluid ether in a vortex state. A vortex in the ether would thus possess rigidity, elasticity, inertia, and all other properties of matter. In the same way a vortex in the atmosphere acquires shape and preserves it like any solid, as well as rigidity and elasticity. Professor Tait's smoke rings, which suggested to Lord Kelvin his ethereal vortex atoms, have all the properties of solid bodies. So, when I treat a revolving mass of air as being dynamically the same as a solid I do what Lord Kelvin has shown is perfectly admissible.[2]

Poisson's general equations for rotary motion of a solid having one fixed point O are given in most works on mechanics and read as follows:

$$
(1)\qquad
\begin{aligned}
C\frac{dw}{dt} + u\cdot v\cdot(B-A) &= L,\\
B\frac{dv}{dt} + u\cdot w\cdot(A-C) &= M,\\
A\frac{du}{dt} + v\cdot w\cdot(C-B) &= N.
\end{aligned}
$$

In these equations u, v, and w are the angular velocities of rotation of a solid body with reference to the three coordinate axes, X, Y, and Z, fixed in space and intersecting at the fixed point O. A, B, and C are the moments of inertia of the solid mass with reference to its own three principal axes, the latter being in motion relative to the three fixed axes. L, M, and N are the moments of the accelerating forces that act upon the body from without taken with reference to the three principal axes.

If we apply these equations to a symmetrical solid of revolution, such as a ring, or an ellipsoid of revolution having its fixed point in its axis of figure, then we obtain the equations for the movement of a gyroscope or rotascope, or a top, and we are able to explain all the motions of those bodies with reference to the support on which they stand. If, however, instead of supposing the revolving body to have a fixed point, we give the latter also a definite motion, as, for instance, when the gyroscope, with its support, is carried with the earth around the earth's axis in its diurnal rotation, we can then deduce the movement of the gyroscope with reference to the meridian of the locality.

If the disk of the gyroscope be supposed to be horizontal, or nearly so, and revolving rapidly about an axis that is vertical, or nearly so, and if its axis is not constrained, but free to move on the earth's surface, we have a case apparently analogous to the movement of a cyclone or hurricane, at least in so far as the latter consists of a mass of air rotating in a horizontal plane. Practically the air within a cyclone is known to be either ascending or descending and changing continually, so that energy is brought into it from without and carried outward from it. If the energies thus added and lost counterbalance each other, we may perhaps hope to deduce from the laws of the gyroscopic motion of a solid some insight into the laws of the motion of the hurricane along the earth's surface.

The above general equations of rotation were in 1858 put into a convenient form for the study of the gyroscope by Major, afterwards General, J. G. Barnard, of the Army Engineers, and his paper is reprinted as No. 90 of Van Nostrand's Science Series.[3] In Major Barnard's little volume the reader will find deduced from fundamental principles the law of gyroscopic motion, which is this: If a spinning gyroscope or a spinning wheel be turned about an axis perpendicular to its own axis of rotation, a deflective force will be developed per-

[20] The periodicity of sun spots and the variations of the mean annual temperatures of the atmosphere. M. Charles Nordmann. Comptes Rendus. Paris, June, 1903. Translation in Monthly Weather Review, August, 1903. P. 371.

[21] The simultaneous variations of sun spots and of terrestrial atmospheric temperatures. Prof. Alfred Angot. Annuaire de la Société Météorologique de France, June, 1903. Translation in Monthly Weather Review, August, 1903. P. 371.

[1] The Editor has retained this paper for a year in hopes that the author would elaborate the mathematical deduction of the formulæ that he uses, but the latter has thought best to simply add a few references to the article by Major Barnard. The reader will find the phenomenon of the gyroscope treated in many modern works on mechanics. The fact that Mr. Cordeiro rests his theory entirely on the assumption that we may deal with the cyclone as if it were a rotating solid deprives his paper of any special interest to the student of hydrodynamics, but his results will, it is hoped, lead others to a more rigorous treatment of the subject.—ED.

[2] The vortex ring of Helmholz and Kelvin constitutes a different sort of motion from that within a cyclone and still more different from that of a simple gyrating mass moving like the particles of a spinning gyroscope. It is, therefore, quite hazardous to assume that the latter will show the mechanical peculiarities of the cyclone. The vortex theory of atoms has been abandoned.—ED.

[3] Analysis of Rotary Motion as Applied to the Gyroscope. By Major J. G. Barnard. D. Van Nostrand, publisher, New York, 1887.

pendicular to the plane in which it is turned. Furthermore, if the "spin" and the turn are both counter-clockwise, this deflecting force will be upward. The measure of this force is (see Barnard, pp. 44 and 57) clearly shown to be

$$g' = k^2 \cdot \frac{\omega}{R} \cdot \frac{d\psi}{dt},$$

where k is the "radius of gyration" of the gyroscope; ω is its angular velocity, or spin; R is the radius of the "turn," e. g., the radius of the earth, and $\frac{d\psi}{dt}$ is the angular velocity of the turning of the axis of spin, due to any cause, e. g., the diurnal rotation of the earth. (See fig. 1.)

This agrees perfectly with what we find in the motions of terrestrial cyclones. The rotation of a mass of air about its axis we may term its "spin;" the motion of the whole about the axis of the earth is its "turn." Therefore, the tendency to motion of the cyclone, as a whole, should, in the Northern Hemisphere, be toward the North Pole; in the Southern Hemisphere, where the spin and the turn are both clockwise as regarded from the outside, the tendency to motion should be toward the South Pole. Both these conclusions agree with the observed motions of the cyclones.[4]

[4] Meteorologists will not forget that in paragraph No. 31 of his classic treatise of 1857, "Motions of Fluids and Solids on the Earth's Surface," published in Runkle's Mathematical Monthly for 1858 to 1860, Prof. William Ferrel was the first to show that on the assumption that the motions of fluids are not resisted by the earth's surface or by their own internal viscosity, it follows that "if the fluid gyrates from right to left the whole mass has a tendency to move toward the north, but if from left to right, toward the south. If every part of a cylindrical mass having its axis of revolution vertical has the same angular velocity of gyration as in the case of solids, then, calling this velocity u, the preceding equation (51) gives for the accelerating force in the direction of the meridian

$$\text{(52)} \qquad \frac{V}{M} = -\frac{g}{578} \frac{u \sin \psi}{n} \left(\frac{s'}{R}\right)^2$$

where g = terrestrial gravity. n = angular velocity of the earth's rotation. s' = small lineal distance from center to exterior of the gyrating mass. R = radius of the earth. ψ = colatitude or polar distance of the center of the gyrating mass of air. u = angular velocity of gyration of the mass."

Again, in articles 70 and 71 Ferrel says:

"The routes of cyclones in all parts of the world, which have been traced throughout their whole extent, have been found to be somewhat of the form of a parabola. Commencing generally near the equator, the cyclone at first moves in a direction only a little north or south of west, according to the hemisphere, when its route is gradually recurvated toward the east, having its vertex in the latitude of the tropical calm belt. This motion of a cyclone may be accounted for by means of what has been demonstrated in section 31, which is, that if any body, whether fluid or solid, gyrates from right to left, it has a tendency to move toward the north, but if from left to right, toward the south. Hence, the interior and most violent portion of a cyclone always gyrating from right to left in the Northern Hemisphere, and the contrary in the southern, must always gradually move toward the pole of the hemisphere in which it is. While between the equator and the tropical calm belt, it is carried westward by the general westward motion of the atmosphere there, but after passing the tropical calm belt, the general motion of the atmosphere carries it eastward, and hence the parabolic form of its route is the resultant of the general motions of the atmosphere and of its gradual motion toward the pole.

"It may be seen from equation (52) that the tendency of a gyrating mass to move toward the pole is as $\sin \psi$ or as the cosine of the latitude and also as the square of the diameter of the gyrating mass. Hence, near the equator, where the dimensions of the cyclone are always small, it moves slowly toward the pole, but as it gradually increases its dimensions, after passing its vertex, its motion toward the pole, and also its eastward motion, are both increased, and hence its progressive motion in its route or orbit is then accelerated, in accordance with the observations of Redfield.

"By comparing equations 27 and 44 it is seen that they are very similar, and consequently the motions which satisfy them must also be similar. Hence, the general motions of the atmosphere are similar to those of a cyclone. For the general motions of the atmosphere in each hemisphere form a grand cyclone having the pole for its center, and the equatorial calm belt for its limit. But the denser portion of the atmosphere in this case being in the middle instead of the more rare, instead of ascending it descends at the pole or center of the cyclone.

These violent revolving storms are usually generated on or near the equatorial border of the trade wind zones. The trade zones are usually separated by a belt called the doldrums, and all together follow the sun in its passage north and south. The southeast trades when they cross the equator assume a southwest direction, the cause of which is well understood; likewise the northeast trades become the northwest trades to the south of the equator. These opposing trades, though usually separated by a narrow belt of doldrums, at times become contiguous along an extended line. Now it can be demonstrated experimentally that when two opposing sheets of wind meet along an oblique line, a whirl will result in a direction from the obtuse toward the oblique angle.

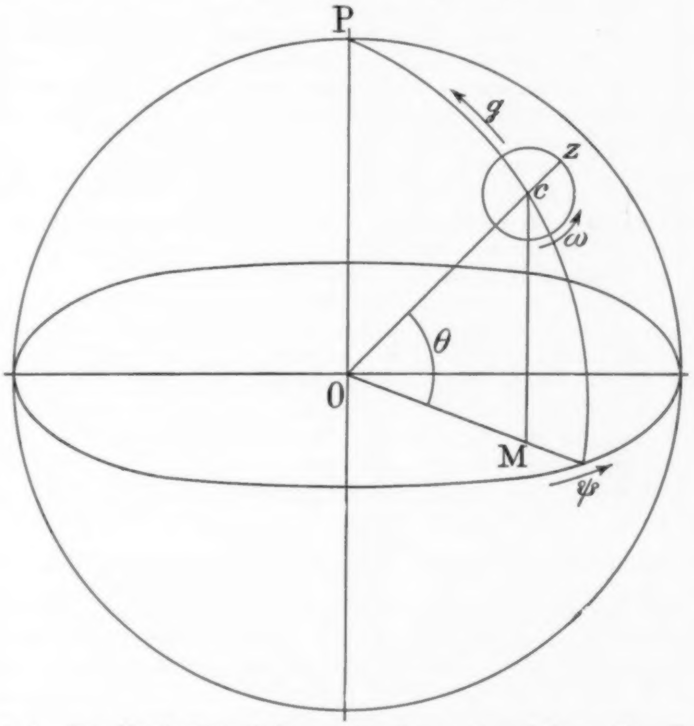


FIG. 1.—P = North Pole of the earth. O = center of the earth. Z = north pole of horizontal cyclone or gyroscope. C = center of cyclone or gyroscope. θ = latitude of C. $OC = R$ = radius of the earth. OM = radius of the small circle of latitude of the cyclone. ω = the spin of the gyroscope or cyclone about its vertical axis CZ in the direction of the arrow. ψ = the turn of the gyroscope or cyclone about OP in the direction of the arrow, due to the diurnal rotation of the earth. q = the deflecting force pushing the cyclone or gyroscope northward, due to the combined action of the spin of the cyclone and the rotation of the earth. The reader will please note that g in Fig. 1 should be q.

In the Northern Hemisphere the opposing trades meeting along a line obliquely will give rise to a contra-clockwise whirl, while in the Southern Hemisphere the whirl must be clockwise.

The ordinary explanation also that the sudden formation of a "low," by precipitation or otherwise,[5] must cause an inrushing of winds will, theoretically, in view of the earth's rotation on its axis, lead to the same results as above. In the one case the theoretical, in the other the experimental demonstration is perfect.

"The southern cyclone having the more rapid motions on account of the resistances from the earth's surface being less, causes a greater depression of the atmosphere there than does the northern cyclone in the Northern Hemisphere, and throws the calm belt a little north of the equator, as has been explained.

"The tendency of the smaller local cyclones, as has been seen, is to run into the centers of the grand hemispherical cyclones, and thus to be swallowed up and become a part of them."

[5] The precipitation of atmospheric moisture into rain or cloud does not directly form a low pressure. The attending evolution of latent heat causes the air and its moisture to simply delay their cooling, so that cloudy air, when freshly formed, is warmer than dry air would be. Of course in a short time the watery particles lose their heat by radiation,

But the object of this paper is to trace, if possible, the subsequent history of this rotating mass of air once it has been formed and become an entity separate from the rest of the atmosphere. Thanks to the labors of Redfield, Reid, Ferrel, and others, we have learned that this rotational energy once started is not easily dissipated, but persists for days and sometimes for weeks. There are undoubtedly many slight whirls, lacking energy and extent, which are soon extinguished by counteracting forces. We shall deal, therefore, only with such vortices as have sufficient energy to preserve a constant rotational energy. Every cyclone must sooner or later be dissipated, but many preserve their energy by precipitation or otherwise, long enough to serve for purposes of investigation. The problem is so complex and so many factors enter into it that an exact solution is impossible. To quote Lord Kelvin: "We may, therefore, at once say that there is no question in physical science which can be *completely* and *accurately* investigated by mathematical reasoning, but that there are different degrees of approximation, involving assumptions more and more nearly coincident with observation, which may be arrived at in the solution of any particular question." We shall attempt, therefore, only approximations, and, while considering the various forces at play, neglect those that we can in the cause of simplicity.

In the first place we shall assume that the rotational energy of the cyclone remains constant during the time it is studied. Now, this will not always be the case. We shall see later on that this quantity may change almost abruptly, but within certain selected limits such an assumption is not inconsistent with tangible results, and, therefore, this is an approximation which, in most cases, will not lead to very large errors. Let ω be the angular velocity of the cyclone and h its radius of gyration, while M is its mass. We postulate, therefore, that the rotational energy or $\frac{M h^2 \omega^2}{2}$ remains constant within the limits of study. If this were not so, the problem could not be attacked, since there could be no ascertainable law by which this energy varied. Now, every one who has studied the subject of hurricanes must have been struck by the remarkably regular curves these bodies trace upon the surface of the earth. The cyclone moves as a whole and in a very regular way. The explanations of this motion have been of the vaguest and, so far as the writer knows, there have been only four:

(*a*) One is that they are blown along by the prevailing winds; but an attempt to verify this would lead only to contradictions, for two cyclones often follow each other over the same area within a short time and pursue utterly different paths. It is hardly necessary to pursue this further.

(*b*) Again, they have been thought to be guided by the coast line, but we shall see later on that this is probably ascribing a cause to an effect. Besides they manage to get along very well without any coast lines.

(*c*) Another explanation has been given that they are influenced by or follow up the Gulf Stream. This is in reality no explanation at all. Besides they do not do so, and they pursue their regular courses where there is no Gulf Stream or any regular current for that matter.

(*d*) Lastly it is customary in official weather reports to read of a cyclone having been "deflected by an area of high pressure" at some distant region. But an examination will show that they move away from or toward areas of high pressure as it may happen, modifying these areas where they reach them, but never being influenced by them.[6]

Now, a cyclone, since it revolves simultaneously about its own axis and about the axis of the earth, is what is known dynamically as a gyroscope. In mechanics we have many instances in which gyrostats, by their motion, reveal the motion of the earth about its axis, and this motion can be calculated by a knowledge of the restraints imposed and the forces applied. In the same manner the motion of a cyclone reveals the motion of the earth about its axis.

It is the object of this paper, if nothing more, to demonstrate that the motion of a cyclone is due to its own intrinsic gyroscopic forces, in other words, that it is a simple question of the dynamics of a certain mass of air revolving about its own axis and the axis of the earth, and of the forces impressed upon it. Further than this, an attempt will be made to calculate this motion and compare it with the observed motion.

A cyclone at the moment of its formation may be stationary relatively to the earth or it may be launched with a velocity relative to the earth's surface in any direction, but in either case, the forces brought into play will soon steady it and start it out upon its proper course.

Chief of these forces is the friction of the earth's surface. We shall consider a cyclone as a material revolving disk, separate and distinct from the remaining atmosphere. This disk has an area immensely greater than its thickness. Consequently, the immense momentum of this mass, moving with its thin edge through the atmosphere, will cause it to meet with no appreciable resistance from this source. It is not certain that we are justified in neglecting this resistance, but the fact that results, calculated on this assumption, agree tolerably well with what is actually observed lead us to believe that we do no great wrong.

But the friction of the cyclone over the earth's surface, both rotational and transitional, must be very great. We see this in the appalling destructive effects of a hurricane, and in the tremendous seas that are raised. Unfortunately the theory of the friction of gases on solids and liquids has never been thoroughly worked out.[7] For lack of further knowledge, we shall assume that this resistance is proportional to the opposed surface and is proportional to the first power of the velocity. It probably also depends somewhat upon the pressure, but this does not concern us, since the pressures throughout remain tolerably constant. We make this assumption because it agrees approximately with the observed facts. It is well to bear in mind that this is probably only an approximation and may be found later on not to be true.

Now, this frictional couple will tend to oppose the rotational energy of the cyclone and bring it to rest, but we have assumed that the cyclone is continually acquiring enough energy from precipitation to preserve its rotational energy tolerably constant.

The component of this frictional couple, however, perpendicular to the earth's axis, will tend to twist it backward about

and the cloud becomes cold. The fall of rain from the cloud is not sufficient to relieve the atmosphere of any great amount of weight, and does not explain the formation of "areas of low pressure." Again, the ascent of a stream of hot air does not directly form a low pressure. The difference in pressure between the top and bottom of a mass of warm air constitutes the so-called buoyancy, and the air will start into an ascending motion when this difference is exceedingly small. The low pressures shown upon our weather maps are not the cause of the inrushing of winds, but on the contrary it is the inappreciable barometric disturbances, so delicate that they are not shown upon our weather maps that cause the inrushing winds: then, the winds, combined with the rotation of the earth on its axis, cause the deeper low pressures that are shown on the daily weather map.

[6] The reader should consult the memoir by the editor, Preparatory Studies for Deductive Methods in Storm and Weather Predictions. Annual Report, Chief Signal Officer, 1889, Part II.—ED.

[7] As the surfaces of the earth and ocean are very rough, they offer a resistance to the motion of the atmosphere, which is a very complex matter, and is mainly made up of what I have called convectional resistances. These resistances are the principle subject of study in the so-called tumultuous motion of liquids and gases, which have been elaborately treated by Boussinesq. For perfectly smooth, solid surfaces, we have to deal only with the viscosity of the fluid. For smooth liquid surfaces, the flow of a gas parallel with the surface gives rise to instability and complex wave motions discussed by Kelvin and especially by Helmholz. Translations or abstracts of these papers are easily accessible.—ED

this axis. In other words, the moment of the momentum of the cyclone as a whole about the earth's axis will continually be diminished.

Now, the projection of the surface of our cyclone upon an equatorial plane increases as the sine of the latitude. It is evident, therefore, that this frictional couple about an axis parallel to the earth's axis will increase as the cyclone moves north (or south for the Southern Hemisphere). In other words, the moment of momentum of the cyclone about the earth's axis will decrease more rapidly the farther north it moves. Now, we have assumed that the frictional resistance is proportional to the surface; the forces of the friction couple, therefore, vary proportionately to the sine of the latitude, but the arm of the couple also increases as the sine of the latitude. It follows then that the moment of the couple tending to reduce the moment of momentum of the cyclone about the earth's axis will increase as the square of the sine of the latitude. The moment of momentum of a cyclone about the earth's axis will, therefore, decrease very much more rapidly in a high than in a low latitude. Mathematically expressed we can put our law in the following form:

$$MR^2 \cos^2 \theta \frac{d\phi}{dt} + Mk^2\omega \sin \theta = C - \int k \sin^2 \theta \, dt,$$

where R=radius of the earth=3437 nautical miles, or 3958 statute miles.

$\frac{d\phi}{dt}$=angular velocity of the cyclone about the axis of the earth and θ is the latitude. M is the mass of the cyclone.

The second term $Mk^2\omega \sin \theta$ represents the component of the moment of momentum of the cyclone due to its proper rotation about an axis parallel to that of the earth. Since it is probable that the moment of momentum of the cyclone about its own axis is small relatively to the momentum of the whole mass about the axis of the earth we shall neglect this term. In doing so we shall introduce a certain amount of error and for more accurate work it would probably be advisable to take cognizance of it. It is difficult to conceive of a greater moment of momentum of a cyclone about its axis than 10,000 M, while the moment about the axis of the earth is very much larger. However, we are here merely sketching a method of attacking the problem.

We shall write, therefore, as an approximate formula

$R^2 \cos^2 \theta \frac{d\phi}{dt} = c - \int k \sin^2 \theta \, dt.$ Let us apply this formula to the Porto Rican hurricane of August, 1899.

At 8 p. m. of August 7 its center was in latitude 16° 50′, and it was traveling with a westward velocity of 13 miles per hour. At 8 p. m. of August 8 its center was in latitude 18° 50′, and it had a westward velocity of nearly 8 miles an hour.

Since at the first point the earth moves 861.5 miles per hour, and at the second point 851.8 miles per hour, the actual velocity of the cyclone at the two points was 848.5 and 844 miles per hour, respectively. The moment of momentum in the first position was, therefore, 2,791,300; in the second position 2,745,700. The difference = 45,600 = $k \sin^2$ 17° 50′ since we take the average value of the latitude for the twenty-four hours. $\therefore \log k = 5.686815$.

Now, let us compute the retarding effect of the friction for some subsequent period of twenty-four hours. We find that at 8 a. m. of August 13 the center of the cyclone was in latitude 27°; at 8 a. m. of August 14 the center was in latitude 29° 30′.

In the former position it was moving about one mile to the westward per hour; in the latter position it was moving directly northward. The moments of momentum were respectively 2,453,000 and 2,343,200. The decrease, therefore, was 109,800. But by our formula we can compute this decrease. Since the average latitude for the period is 28° 15′; we have

$$\begin{aligned} \log \sin^2 28° \, 15' &= 9.350310 \\ \log k &= 5.686815 \\ \hline & 5.037125 \end{aligned}$$

the product corresponds to 108,925.

The agreement in this case is very close. However, to plot the position of the center of a cyclone accurately is very difficult as well as the determination of its speed at a given point, so that we may expect a moderate difference between the observed and computed values. Their general agreement, however, in a number of cyclones which the writer has studied, leads him to believe that the law is a close approximation, perhaps actually true.

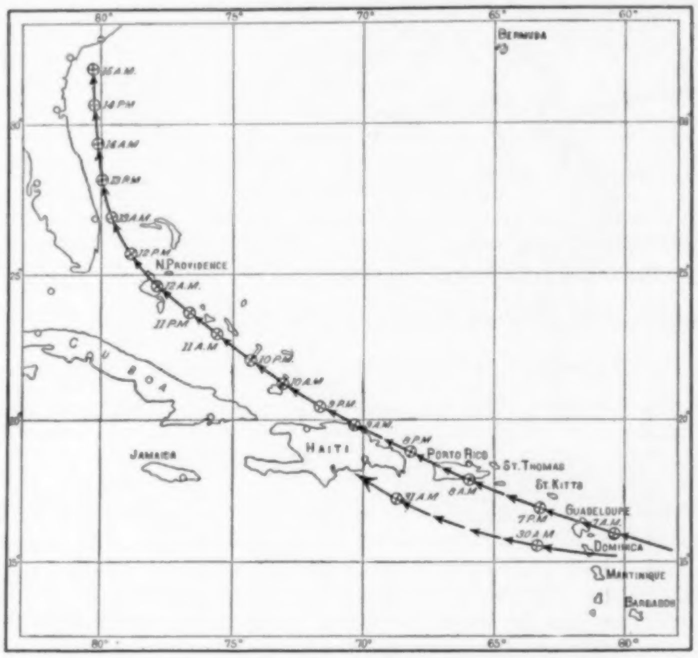


FIG. 2.—Porto Rican hurricane of August 7, 1899.

Let us consider the intermediate portion of the same cyclone. At 8 a. m., August 10, the center was in latitude 21° 20′ and was traveling westward 6 miles an hour. At 8 a. m., August 11, the center was in latitude 23° and was still going westward at about the rate of 6 miles an hour.

$$\begin{aligned} \text{Moment of momentum at first point} &= 2,665,250 \\ \text{Moment of momentum at second point} &= 2,602,240 \\ \hline \text{Difference} &= 63,010 \end{aligned}$$

Now, the average latitude for the period was 22° 10′.

$$\begin{aligned} \log \sin^2 22° \, 10' &= 9.153378 \\ \log k &= 5.606815 \\ \hline \log 69,210 &= 4.840193 \end{aligned}$$

It may seem that this is not a very close agreement, but it is within the limits of accuracy with which the positions can be plotted.

These positions have been taken from the Weather Bureau chart and are interpolations, but surprisingly accurate, considering that in this portion of its track the storm was at sea, far removed from all observation stations. If, for instance, the position at 8 a. m., August 10, was latitude 21° 10′ instead of 21° 20′, as we took it above, the observed and computed values in question would be 68,560 and 68,720, respectively.

The Porto Rican hurricane, therefore, throughout its course, as given by the Weather Bureau, followed very closely the law

$$R^2 \cos^2 \theta \frac{d\varphi}{dt} = C - K \int \sin^2 \theta \, dt,$$

and the same has been found to be the case with some other hurricanes, for which the writer has been able to obtain reliable data. In some other cases the agreement is not so close.

We shall now consider the strictly gyroscopic character of the cyclone. Since it is whirling about its own axis and at the same time about the axis of the earth, a polar acceleration must be developed. This can be easily demonstrated by a toy gyroscope. If such a gyroscope as is shown in fig. 3 be held in the hand and given a smart spin counter clockwise and then turned in the direction indicated by the arrow, imitating the motion of a cyclone, a strong force will be felt, tending to raise the instrument. The law of the gyroscope is that if the axis be turned about some fixed point, a force will be developed normal to the plane in which the axis is turned. When the two rotations are as in the figure, this normal deflecting force will be upward.

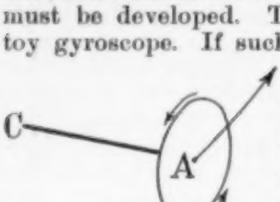


FIG. 3.

Further, this force will be equal to $g = \frac{k^2\omega}{R}\frac{d\psi}{dt}$, where k and ω are, respectively, the radius of gyration and the angular velocity of the gyroscope, and $\frac{d\psi}{dt}$ is the angular velocity with which the axis is turning. R is the radius with which the axis turns, or the distance CA. This explains the constant northing or southing in the respective hemispheres which is observed in all true cyclones.

Now, if our cyclone moved over the surface of the earth without any friction it would be easy to compute its motion. If θ represents its latitude at any point, and ψ its longitude, and we suppose it to start from some point $(\theta_\circ, \psi_\circ)$; the differential equations of the motion would be

1 $$\frac{k^2\omega}{R}\frac{d\theta}{dt} = -D_t\left(R\cos\theta\frac{d\psi}{dt}\right) \text{ and}$$

2 $$\frac{k^2\omega}{R}\cos\theta\frac{d\psi}{dt} = R\frac{d^2\theta}{dt^2},$$

where R, of course, represents the radius of the earth. If we represent the actual horizontal velocity of the cyclone by v_h and the polar velocity by v_p and integrate[7] the above equations, we have

$$v_h = V - \frac{k^2\omega}{R}(\theta - \theta_\circ)$$

and

$$v_p^2 = 2\frac{V}{R}k^2\omega(\theta - \theta_\circ) - \left(\frac{k^2\omega}{R}\right)^2(\theta - \theta_\circ)^2.$$

V represents the initial velocity of the starting point or the velocity with which this point on the earth's surface is moving about the earth's axis. In such an ideal frictionless case it is easily seen that the resultant velocity is $v_h^2 + v_p^2 = V^2$. And this must be the case, since no energy is expended. But the forces which we are considering, in moving the cyclone over the earth's surface, have to do considerable work in overcoming friction. Consequently the sum total of the energy of the system is continually diminishing, albeit the rotational energy of the cyclone may be preserved nearly constant by energy acquired from precipitation.

As the frictional couple which we have considered in connection with the moment of momentum must affect chiefly the horizontal velocity, it will be at once seen that the equation $v_h = V - \frac{k^2\omega}{R}(\theta - \theta_\circ)$ can not hold for a cyclone. The polar velocity, however, will not be so much influenced, and it is probable that the law

$$v_p^2 = 2\frac{V}{R}k^2\omega\ (\theta - \theta_\circ) - \left(\frac{k^2\omega}{R}\right)^2(\theta - \theta_\circ)^2$$

may approximately hold. Stated in general terms this law can be written

$$v_p^2 = K(\theta - \theta_\circ) - K^1(\theta - \theta_\circ)^2$$

where the constants will depend upon our selection of units. Let us apply this to some actual cyclones. I have taken two of these as charted by Piddington (Sailor's Hornbook) from data given by Reid and Redfield. The first originated in latitude 15° north, longitude 77° west, September 27, 1837.

We must bear in mind the difficulty even to-day of plotting accurately the position of a cyclone center, and that, therefore, the daily positions as given by Reid and Redfield may be subject to some error. We shall, therefore, aim only at approximate results. Let us take our velocities in nautical miles per hour, and our latitude in degrees reckoned from the starting point, viz, 15°.

We find that from September 27 to 28 it was moving northward about 3 miles an hour. Again from October 9 to 10 it had about that same velocity. Substituting in our equation $v_p^2 = K\theta - K^1\theta^2$ we have $9 = K - K^1$ and $9 = 19K - 361K^1$. $\therefore K = 9.47$ and $K^1 = 0.47$. From the formula we see that v_p has a single maximum velocity, and this occurs where $K = 2K^1\theta$. In the present case this would correspond to about latitude 25°; and the velocity itself is $v_p^2 = 94.7 - 47 = 47.7$. The maximum velocity is therefore, about 7 miles per hour, which corresponds with that which actually occurred.

Piddington charts a cyclone which began some time in October, 1846, in latitude 14° north and longitude 77.5 west. He plots only the positions it had on October 11, 12, 13, and 14. On October 11 the center is plotted at latitude north 25°, and going northward at the rate of 15 miles an hour. On October 12 it was at 31° north latitude, and traveling northward at the rate of 17.5 miles an hour. We can, therefore, write

$$225 = 11K - 121K^1$$
$$306 = 17K - 289K^1$$

whence

$$K = 26.63$$
$$K^1 = 0.33.$$

October 13 the cyclone is plotted at latitude 38° north. Let us see what the poleward velocity should be: $v_p^2 = 24K - 576K^1$, therefore, $v_p = 21$. Actually it was about 22.5. We also find that this cyclone would have attained its maximum poleward velocity in latitude 54°, and not, as in the previous cyclone, at about the point of recurvation. From these two examples, as well as from a number of others, we may conclude that the poleward velocity is approximately that due to the gyroscopic forces generated, and is not influenced much by frictional forces. But that it is to some extent influenced by such forces must be self-evident.

The object of the writer will have been satisfied if he has demonstrated why a cyclone moves, and how the nature of this motion is dependent upon the forces called into play. The

[7] The successive steps of the integration of these equations are as follows. Integrating (1) we have

$$k^2\frac{\omega}{R}\cdot\theta = -R\cos\theta\frac{d\psi}{dt} + K$$

where K is a constant, depending upon the initial conditions of motion. If the cyclone starts from latitude $\theta_\circ$ with the same velocity as the surface of the earth at that point, we have

$$v_h = V - k^2\frac{\omega}{R}(\theta - \theta_\circ)$$

where v_h represents the velocity at any time projected upon the plane of the equator.

Since, after the initial impulse, no forces are supposed to act on the gyroscope, the velocity, V, must remain constant throughout. Therefore, $v_h^2 + v_p^2 = V^2$, hence,

$$v_p^2 = 2Vk^2\frac{\omega}{R}(\theta - \theta_\circ) - \left(k^2\frac{\omega}{R}\right)^2(\theta - \theta_\circ)^2.$$

These equations represent the motion of a frictionless cyclone, as has been stated before, but applying the correction for friction, we get the motion of a natural cyclone.

question naturally arises whether it is possible, or will ever be possible, from a few given initial positions to predict the subsequent path. It will be noted that in the whole preceding discussion the energy of rotation of the cyclone has been supposed to be constant, or at least constant within certain limits. Now, this is never actually the case, though very often it is approximately so.

In the case of the last cyclone discussed it would be possible to trace its course beyond October 13, although no further record has been left us. By the law of the diminishing moment of momentum we might obtain the relative horizontal velocity for the 14th, and this, with the polar velocity which we have already calculated, would give us its position for that day. We could then plot its course for the next day, and the next, and although this path would not coincide with the one actually traced, it would give us an approximate idea of its subsequent course. But although many cyclones might have their paths predicted in advance with more or less accuracy, it is certain that others could not. The course of the Galveston hurricane could not in any way have been foreseen up to the morning of the 6th of September, 1900. Previous to that time it was a general disturbance of no very great intensity, extending over pretty much the whole of the Caribbean Sea. It is extremely difficult to plot the center of this disturbance from day to day, and, therefore, it is out of the question to attempt to deal with it analytically. But after the 6th it contracted, concentrating its energy, and becoming for all practical purposes a totally new and different cyclone. Such an abrupt change in the parameters can not be dealt with.

The problem of forecasting the track of a cyclone may later on, with increasing knowledge and more accurate measurements, be placed upon an entirely satisfactory basis. The present paper is merely a preliminary sketch, discussing the nature of the problem and giving some hints as to how it may be attacked.

In this article I have not "picked out a few cases of close agreement," but simply used the very meagre material accessible to me. It is my earnest desire to get more data of a reliable nature, and eventually find an opportunity to analyze the motion of hurricanes.

I believe that I have shown that the motion of cyclones is due to ordinary dynamical laws inherent in themselves. In some cases this motion can be predetermined. I do not pretend to say at present that the path of every cyclone can be predicted, especially where the governing quantities, or the *parameters* are changing in no ascertainable way—but in a number of cases where the moment of inertia remains tolerably constant, or where there is a constant rotational energy, as is the case in the heavy tropical hurricanes, we may predetermine a path with a considerable degree of accuracy.

Before closing, the writer desires to call attention to the remarkable conformity existing between our cyclone curves and the disposition of the coast line throughout the West Indies and the North American Continent. The Greater Antilles, the Gulf of Mexico, and the Atlantic coast line are arranged along cyclone curves. This has led some writers to ascribe the form of the cyclone path to the configuration of the coast line. The exact opposite is probably the fact.

RECENT PAPERS BEARING ON METEOROLOGY.

Dr. W. F. R. PHILLIPS, Librarian, etc.

The subjoined titles have been selected from the contents of the periodicals and serials recently received in the Library of the Weather Bureau. The titles selected are of papers or other communications bearing on meteorology or cognate branches of science. This is not a complete index of the meteorological contents of all the journals from which it has been compiled; it shows only the articles that appear to the compiler likely to be of particular interest in connection with the work of the Weather Bureau. Unsigned articles are indicated by a ——.

Science. New York. N. S. Vol. 18.

Rotch, A. Lawrence. Meteorology at the British Association. Pp. 657-661.

Ward, R. DeC. Blood counts at High Altitudes. [Note on Nos. 8 and 9 of Vol. III, Bulletin of the Hadley Climatological Laboratory of the University of New Mexico.] P. 731.

Ward, R. DeC. West India Hurricanes. [Note on work of James Page.] Pp. 731-732.

Ward, R. DeC. Cloud Observations at Simla. [Note.] P. 732.

Scientific American. New York. Vol. 89.

—— The Lebaudy Airship. P. 411.

Trowbridge, John. The Noise of Lightning. P. 461.

Nollen, John. Optical Atmospheric Phenomena. P. 463.

Scientific American Supplement. New York. Vol. 56.

Baden-Powell, B. F. S. Recent Aeronautical Progress, and deductions to be drawn therefrom, regarding the future of Aerial Navigation. Pp. 23310-23312.

Finn, William. Influences of the Sunspots upon Electrical and Magnetic Forces of the Earth. Pp. 23351-23352.

—— Lebaudy Airship Disaster. P. 23384.

Nature. London. Vol. 69.

Arcimis, Augusto. Telegraphic Disturbances in Spain on October 31. P. 29.

Talbot, J. Variation of Atmospheric Absorption. P. 30.

Everett, J. D. Rocket Lightning. P. 30.

West, R. A. Explosive Action of Lightning. P. 31.

Backhouse, T. W. Volcanic Dust, the "New Bishop's Ring," and Atmospheric Absorption. P. 81.

Quarterly Journal of the Royal Meteorological Society. London. Vol. 29.

Shaw, W. N. The Meteorological Aspects of the Storm of February 26-27, 1903. Pp. 233-262.

Hooker, C. P. The Relation of the Rainfall to the Depth of Water in a Well. Pp. 263-282.

Higginson, E. Climate of Peru. P. 282.

Marriott, W. The Frost of April, 1903. Pp. 283-288.

—— Cricket and Rainfall. P. 288.

—— Lightning Photography. P. 288.

Baxendell, J. Description of the Dines-Baxendell Anemograph, and the Dial-Pattern Non-Oscillating Pressure-Plate Anemometer. Pp. 289-298.

—— The Employment of Means in Meteorology. P. 298.

Dines, W. H. Investigation of the Upper Atmosphere by Means of Kites. Pp. 310-311.

Starr, W. H. Climate of Wei-Hai-Wei. Pp. 312-313.

—— Meteorological Observations in the British Central Africa Protectorate. Pp. 314-315.

Symons's Meteorological Magazine. London. Vol. 38.

—— The Rainfall of October, 1903, [in England.] Pp. 169-172.

N., W. C. Greenwich rainfall, 1841-1902. Pp. 177-179.

Mill, Hugh Robert. The Unexampled London Rainfall of 1903. Pp. 179-181.

Mill, Hugh Robert. On the Rate of Fall at Seathwaite. P. 182.

Knowledge. London. Vol. 26.

Damania, P. J. Radium and the Sun's Heat. P. 255.

Cobbold, Paul A. Curious Sunset Phenomena. P. 256.

Maunder, Walter. The Sunspots of 1903, October. Pp. 275-278.

Scottish Geographical Magazine. Edinburgh. Vol. 19.

—— Climate of the Philippines. [Abstract of article of Walter S. Tower.] P. 653.

—— Climate and Vegetation of Guatemala. [Abstract of article of Gustav Eisen.] Pp. 654-657.

—— Climate and Soil of the Samoa Islands. [Abstract of article of Vohltmann.] P. 660.

London, Edinburgh, and Dublin Philosophical Magazine. London. 6th Series. Vol. 6.

Adams, E. P. Water Radioactivity. Pp. 563-569.

Simpson, George C. On Charging through Ion Absorption and its Bearing on the Earth's Permanent Charge. Pp. 589-598.

Townsend, John S. The Genesis of Ions by the Motion of Positive Ions in a Gas, and a Theory of a Sparkling Potential. Pp. 598-618.

Proceedings of the Royal Institution of Great Britain. London. Vol. 17.

Dewar, —. Problems of the Atmosphere. Pp. 223-230.

Astrophysical Journal. Chicago. Vol. 18.

Runge, C. On the Spectrum of the Aurora. Pp. 381-382.

Geographical Journal. London. Vol. 22.

Evans, John William. [Climate of Caupolican Bolivia, account given in, Expedition to Caupolican, Bolivia, 1901-1902]. Pp. 639-642.

American Journal of Science. New Haven. 4th Series. Vol. 16.

Wieland, G. R. Polar Climate in Time the Major Factor in the Evolution of Plants and Animals. Pp. 401-430.

Ciel et Terre. Bruxelles. 24me année.

—— La perturbation magnétique du 31 octobre 1903. Pp. 417-427

Debrowolski, A. Quelques idées sur la forme et sur la structure des cristaux de neige. Pp. 427-438.

Debrowolski, A. Quelques idées sur la forme et sur la structure des cristaux de neige. Pp. 449-459.

—— La perturbation magnétique du 31 octobre. [Note.] Pp. 465-468.

Comptes Rendus de l'Académie des Sciences. Paris. Tome 137.

Guillaume, Ch. Ed. Remarques sur la note de M. P. Ditisheim, relative à l'action de la pression atmosphérique sur la marche des chronomètres. Pp. 703-705.

Moureaux, Th. Sur la perturbation magnétique du 31 octobre 1903. Pp. 705-706.

Quénisset, F. Remarques sur le dernier groupe de taches solaires et les perturbations magnétiques. Pp. 747-748.

Marchand, Ém. Quelques remarques sur la perturbation magnétique du 31 octobre 1903. Pp. 789-792.

Deslandres, H. Relation entre les taches solaires et le magnétisme terrestre. Utilité de l'enregistrement continu des éléments variables du soleil. Pp. 821-827.

Guillaume, J. Le dernier minimum des taches du soleil et remarques au sujet de la loi des zones. Pp. 898-900.

Annuaire de la Société Météorologique de France. Paris. 51me année.

Raulin, V. Sur les observations pluviométriques en Australie de 1881 à 1900. Pp. 149-176.

Coeurdevache, P. Fréquence des jours d'orage dans les Pyrénées Orientales. Pp. 179-180.

Lahille, A. Le cyclone du 8-9 août à la Martinique. Pp. 180-183.

La Nature. Paris. 31me Année.

Quénisset, F. Grande tache solaire. Pp. 330-331.

Quénisset, F. Le soleil et les perturbances magnétique. P. 370.

Annales de Chimie et de Physique. Paris. 7me séries. Tome 30.

Curie, Sklodowska (Mme.) Recherches sur les substances radio-actives. Pp. 289-326.

Aerophile. Paris. 11me années.

Vaulx, H. de La. De Paris au comté d'York (Angleterre); le voyage du Djinn et la théorie du général Meusnier; journal de bord du Djinn. Pp. 232-239.

Bulletin de la Société Belge d'Astronomie. Bruxelles. 7me année.

Vincent, J. La météorologie jugée par un astronome. Pp. 334-338.

Archives des Sciences Physiques et Naturelles. Genève. 4me période. Tome 16.

—— Observations météorologiques faites aux fortifications de Saint-Maurice pendant les mois de décembre, 1902, janvier et février, 1903 (hiver 1903). Pp. 435-442.

Physikalische Zeitschrift. Leipzig. 4 Jahrgang.

Stark, J. Die Eigenschaften des Glimmstromes in freier Luft. Pp. 715-717.

Lecher, E. Ueber die Anwendung des elektrodenlosen Ringstromes zur Widerstandsmessung verdünnter Luft. Pp. 811-814.

Annalen der Physik. Leipzig. Vierte Folge. Band 12.

Toepler, M. Ueber Beobachtungen von kurz dauernden Luftdruckschwankungen (Windwogen.) Pp. 787-804.

Mitteilungen von Forschungsreisenden und Gelehrten aus den Deutschen Schutzgebieten. Berlin. Band 16.

—— Resultate der Regenmessungen in Tafle am Agu. P. 208.

—— Resultate der meteorologischen Beobachtungen in Swakopmund im Jahre 1902. Pp. 216-217.

—— Meteorologische Beobachtungen aus den deutschen Schutzgebieten der Südsee für das Jahr 1902. Pp. 231-240.

Annalen der Hydrographie und Maritimen Meteorologie. Berlin. 130 Jahrgang.

—— Wetterkarten vom Nordatlantischen Ozean für den 1. bis 10. April 1903. Pp. 473-474.

—— Die Staubfälle vom 19. bis 23. Februar 1903 über dem Nordatlantischen Ozean, Grossbritannien und Mitteleuropa. Pp. 475-483.

Börgen, C. Ableitung der harmonischen Konstanten der Gezeiten aus drei täglichen Wasserstands-Ablesungen zu bestimmten Stunden, nebst Bearbeitung dreijähriger Beobachtungen zu Kamerun. Pp. 483-492.

Das Weltall. Berlin. 4 Jahrgang.

Archenhold, F. S. Sonnenflecken, Erdströme und Nordlichter. Pp. 71-75.

Krebs, Wilhelm. Die Gezeitenbewegungen der Atmosphäre. Pp. 91-96.

Das Wetter. Berlin. 20 Jahrgang.

Schulze, Paul. Resultate aus den meteorologischen Beobachtungen in Meitzen von 1855-1902. Pp. 241-250.

Ziegra, Alfred. Untersuchungen der "Nachtfrostprognose nach Kammermann" für mehrere meteorologische Stationen Nord-und Mitteldeutschlands. Pp. 250-256.

Schiefer-Mahlburg, Eduard von. Ueber atmosphärische Staubfälle. Pp. 258-263.

Meteorologische Zeitschrift. Wien. Band 20.

Trabert, W. Die Theorie der täglichen Luftdruckschwankung von Margules und die tägliche Oszillation der Luftmassen. Pp. 481-501.

Hann, J. Ueber eine doppelte tägliche Periode der Windkomponenten auf den Berggipfeln. Pp. 501-512.

Sapper, Karl. Meteorologische Beobachtungen, angestellt in der Republik Guatemala im Jahre 1901. Pp. 512-516.

Hann, J. J. R. Sutton: Experimente über Verdunstung. Pp. 517-518.

Sassenfeld, Max. Zur Häufigkeit der Halophänomene. Pp. 518-519.

—— Der Bishopsche Ring. Pp. 519-520.

Hann, J. Regenbogen im Nebel auf dem Bodensee. Pp. 520-521.

Handel-Mazzetti, Eduard von. Zur Häufigkeit des "Nebelbildes." Pp. 521-522.

H[ann], J[ulius]. K. Hetz: Ueber die Gewitter in der Schweiz. Pp. 522-523.

—— Meteorologische Beobachtungen zu Banani, Insel Pemba, Ost-Afrika. P. 523.

Kassner, C. Strenge und schneereiche Winter in Nordamerika nach Indianerberichten. Pp. 523-525.

Wolfer, A. Provisorische Sonnenflecken-Relativzahlen für das III. Quartal 1903. P. 525.

—— Eduard Mazelle: Ueber die mikroseismische Pendelunruhe und ihren Zusammenhang mit Wind und Luftdruck. Pp. 525-527.

Boletin del Instituto Cientifico y Literario "Porfirio Diaz." Toluca. Tomo 6.

—— Programa del curso de fisica y nociones de meteorologia. Pp. 238-240.

Boletin Agricola. Arequipa. Tomo 2.

M., M. V. Synópsis general de los meses de estío del año 1902-1903. Pp. 108-111.

Boletim da Sociedade de Geographia de Lisboa. Lisboa. 21 Série.

Berthoud, Paul. Meteorologia de Lourenço Marques. Pp. 269-271.

CLOUDS ON THE CUCAMONGA MOUNTAINS.[1]

By Mr. G. R. ROUNTHWAITE, dated Avalon, Santa Catalina Island.

I am sending you solio prints of the storm on the Cucamonga Mountains, also a solio print of the same mountains taken on the following morning. The panoramic view of the mountains (figs. 1 and 2) was taken about 4 p. m. with the rear combination of a rapid rectilinear lens and a Bausch and Lomb color screen, or ray filter, at an elevation of 925 feet above sea level and at a distance of about 35 miles from the mountains. The summit of Cucamonga Peak is about 9800 feet above sea level. The trees in the foreground are orange trees on the Arlington Heights district of Riverside. The following points are indicated by numbers on the print:

1, 1. Sand flats of southeast Ontario. The wind coming over the mountains and through Cajon Pass is so strong that the sand is raised in the air thick enough to obliterate the view of the mountains beyond. Railroads have much trouble with the sand blowing into the cuts, and they guard against it by fences similar to the snow fences in the north. The hills in the mid-distance seem to concentrate the wind over these flats. There is now an immense vineyard planted in this district.

2, 2. The mouth of San Antonio Canyon and the higher citrus lands of Ontario Colony at the head of Euclid avenue.

3, 3. The citrus colony at Iomosa, which gets its water from the stream in Cucamonga Canyon.

4, 4. Northrup and Hurd's ranch, where oranges, lemons, plums, peaches, prunes, and olives are raised; the water supply comes from a tunnel into the mountains.

5, 5. De Mense, a citrus orchard of 40 acres; this also has a private water right through a tunnel into the mountains.

9, 9. Cajon Pass. Notice the cigar-shaped cloud crossing behind the trees. I have been at point 4, 4 and distinctly heard the roar of trains coming and going in this pass.

[1] Prof. Alexander G. McAdie forwards to the Monthly Weather Review a letter from Mr. G. R. Rounthwaite, dated Avalon, Santa Catalina Island, off the coast of southern California, but relating to some photographs of the Cucamonga Mountains, taken from Arlington Heights, latitude 33° 55′ north, longitude 117° 25′ west, and looking nearly due north. The Cucamonga Mountains lie between the observer and the Cajon Pass between the San Gabriel Range and the San Bernardino Range; one branch of the Southern California Railroad passes through Cajon Pass.

We reproduce Mr. Rounthwaite's beautiful photographs in figs. 1, 2, and 3.

FIG. 1.—Left-hand portion of panoramic view of a storm on the Cucamonga Mountains. 1, 1. Sand flats of southeast Ontario. 2, 2. The mouth of San Antonio Canyon. 3, 3. The citrus colony at Iomosa. 4, 4. Northrup and Hurd's Ranch. 5, 5. DeMense, a citrus orchard. 6, 6. Ontario Peak. 7, 7. Cucamonga Peak. 8, 8. Mr. J. D. Carscaden's residence on Arlington Heights, Riverside.

FIG. 2.—Right-hand portion of panoramic view of a storm on the Cucamonga Mountains. 9, 9. Cajon Pass; Sante Fe and Salt Lake railways enter southern California through this pass. 10, 10. Hills in West Riverside District, about midway between the mountain and the location of the camera. 11, 11. Residence of Mr. J. H. Thompson. 12, 12. South Adams street, Arlington Heights, Riverside.

14
13

13 14

FIG. 3.—General view of Old Baldy and Cucamonga Mountains looking toward north-northeast. 13, 13. The round head of Old Baldy at the head of San Antonio Canyon. 14, 14. The summit of the highest peak, Cucamonga.

In the single view, fig. 3, also taken with the same rear combination and ray filter, the following points will be noticed:

13, 13. The round head of Old Baldy, at the head of San Antonio Canyon, which is 15 miles beyond the head of Cucamonga Canyon.

14, 14. The summit of the highest peak, Cucamonga.

Fig. 3 was taken about 7 a. m. and shows with what rapidity the storm clouds of three days previous have been swept from the sky by the north wind. We expect danger from the frosts in the citrus orchards succeeding a day of such clear, cold weather on the mountains, but in nearly all cases the frost is happily averted by a slight wind, and the thermometer goes to its lowest point during the hour before sunrise, dropping say from 36° to 26° in an hour, and rising again after the sun comes up. These north winds are charged with electricity, which visibly affects the hair in the manes and tails of horses, and causes an exceeding irritability and depressing headache in some human beings. These conditions generally exist for a period of three days, and although the wind blows hard it rarely causes much damage to trees or fruit in the orchards.

THE EARTHQUAKE OF DECEMBER 5, 1903, AT WASHINGTON, D. C.

By Prof. Charles F. Marvin.

The seismograph of the Weather Bureau recorded a slight earthquake from a very distant origin on the night of December 4–5, 1903. The apparatus by which this record was made has already been described in the MONTHLY WEATHER REVIEW for June, 1903, page 271. The north and south component of horizontal motion only is recorded.

The "principal portion" of the earthquake was noticeably short; the first portion consisting of only two or three waves of small amplitude, but relatively long periods (fifteen seconds for the duration of one complete vibration) followed by a single, relatively long wave with about the same period, and representing a displacement of the ground of about 0.26 of a millimeter (double amplitude). The period of the pendulum is 26 seconds, and the magnification 10.

The following table gives the corrected times of the principal phases of this earthquake:

December 5, 1903, a. m., seventy-fifth meridian time.

	h.	m.	s.	h.	m.	s.
First preliminary tremor				0	26	20 a. m.
Second preliminary tremor				0	32	32 a. m.
Duration of first preliminary tremor	0	6	12			
Duration of second preliminary tremor	0	3	13			
Principal portion began				0	35	45 a. m.
Principal portion ended				0	36	50 a. m.
Duration of principal portion	0	1	15			
Duration of end portion	0	24	42			
End of earthquake				1	1	32 a. m.

This is the third earthquake that has been distinctly recorded at the Weather Bureau since the present seismograph was installed about the middle of February, 1903.

MOUNT WHITNEY AS A SITE FOR A METEOROLOGICAL OBSERVATORY.

By ALEXANDER G. MCADIE, Professor of Meteorology.

In reply to a letter dated June 15, 1903, from the Chief of the Weather Bureau, asking for a report on the advantages and disadvantages of Mount Whitney as a site for a meteorological observatory in connection with the proposed astrophysical observatory, I have the honor to submit the accom-

panying notes based on observations made during a hasty trip to the summit in July, 1903, in company with the Sierra Club of San Francisco.

ACCESSIBILITY.

Mount Whitney is situated in latitude 36° 34′ 33″ north, and longitude 118° 17′ 32″ west. It may be reached in several ways.

I. From Lone Pine on the Carson and Colorado Railroad, along the county roads to Carroll Creek, up zig zags of a trail, across Cottonwood Creek to Horseshoe Meadow, a climb of nearly 5000 feet in 10 miles, and thence by trail to Volcano Mountain.

II. By trail from the Kern River, at its southern end, working north along the Kern River to the East Fork, thence south to Crabtree Meadow, thence to Langley's Camp on the eastern side of Mount Whitney, 2800[1] feet below the summit.

III. From the northern end of Kern River working south to East Fork, thence as in II.

The trails on the western side of the mountain are not steep, nor especially difficult and dangerous. A good climber can go from Langley's Camp to the summit in less than four hours.

On the top of the mountain, or peak, is a flat of several acres. On the extreme eastern edge, a small monument of rocks has been erected. The eastern side of the peak is precipitous, a sheer fall of about 6000 feet sharply marking the mountain. About 11,000 feet below the summit lies the valley of Owens River, with Owens Lake to the southeast. On a clear, quiet day Lone Pine, almost directly east of Mount Whitney and distant about 15 miles, can be seen. Independence, lying to the north-northeast, is hidden by a ridge. Between Independence and Lone Pine six streams flow to the east. The most important of these is Lone Pine Creek, which flows down from Mount Whitney. According to the report of Mr. Charles C. Garrett, Observer at Independence, Cal., dated June 17, 1903, the quantity of water in this creek is as follows:

> The flow of the stream varies very much in different years. Measurements taken two days ago at my request showed a flow of 660 miner's inches. The water is now at its highest point, and this is regarded as an average year. It is probable that at the time of lowest water not more than 80 inches flow. Measurements were taken in the months of October and December, 1893, for testimony in a water suit, and flows of 195 and 160 inches, respectively, were found. The principal owner of the waters of Little Pine Creek informs me that, in his opinion, the average flow of the stream for an average year is about 300 miners' inches.

On the eastern side of the mountain there are at least four lakes within 3 miles. There is a splendid supply of good water at Langley's Camp. Mount Whitney is in the Mount Whitney Military Reservation, and I am under the impression that one of the reasons urged in establishing the reservation was the desire to retain it for use as a station for scientific research.

The peculiar character of Mount Whitney renders it a good site for meteorological work, inasmuch as comparisons can be made of the conditions in the free air over a confined and heated valley and the conditions existing on the westward slope of the Sierra, or plateau conditions. While we were on the summit a lady's veil was thrown over the eastern edge, and, although the temperature was but 53°, it was plain that there were high temperatures and strong ascensional currents on the eastern side of the mountain. The course of the veil was such as to suggest that with regard to the general flow of the air from west to east the mountain acts as a dam, or weir.

It is probable that for the greater portion of the year the peak is accessible. The average precipitation in this section is not very large. Snow remains in the crevasses until August or September. At the time of our ascent, July 8, 1903, we passed across one crevasse which, however, could have been avoided by making a detour south of the gully. I do not know that the peak has ever been ascended in winter, but I believe there are periods when this would be possible. No one of the other high mountains on the Pacific slope, such as Shasta or Rainier, is so easy to climb as Mount Whitney. Owing to the fact that the two peaks mentioned lie further north and in the track of atmospheric disturbances, climbing is almost out of the question in winter, and hazardous even in summer. Mount Whitney, therefore, of all the extremely high peaks on the Pacific coast, is probably most suitable for a meteorological observatory.

All materials would have to be carried up by pack train. I made some inquiry as to prices for this work, but could obtain no trustworthy estimates.

[1] 3000 feet is probably a more accurate figure.

THE ELEVATION OF MOUNT WHITNEY.

As will be seen below few mountain elevations have been discussed more carefully than that of Mount Whitney. Some barometric observations were made on our trip, although it was a hasty one and not altogether favorable for such work. Fortunately the weather conditions were very favorable. The greatest care was taken by Prof. J. N. LeConte and myself to read carefully, and independently of each other, the heights of the mercurial column. Our chief purpose was to correct the prevailing estimate of the height of Mount Whitney, viz, 14,900 feet, an elevation given on most of the maps in use in California.

Gannett, in his Dictionary of Altitudes in the United States, third edition, 1899, gives an elevation of 14,898 feet, and this we believe to be erroneous. The authority given is Whitney, but I am unable to ascertain if Professor Whitney made the ascent and measurement, or, as chief of the geological survey of California, used the measurement made by Carl Rabe for the Survey. This latter was the first measurement of Mount Whitney. His readings as marked on the case of the mountain mercurial barometer, Green No. 1554, used by him, are 17.836 inches, 32°; 17.848 inches, 42°.

The elevation deduced from the above readings was 14,898 feet, or exactly the same as the figures given by Gannett. This elevation, however, does not seem to be in accord with the readings, and if the altitude is determined on the assumption that the correction applied to the barometer was the same as applied in our observations (a doubtful assumption it is true), the elevation would be about 13,701 feet, the sea-level pressure on that date being 30.01 inches at the given hour, the value of the mean temperature being 37.5 °F. and the corrected reading at Mount Whitney being 17,915 inches.

Two mercurial barometers were carried from San Francisco to Mount Whitney summit and read at half hourly intervals by Prof. J. N. LeConte, University of California, and myself. One of the barometers was the same instrument used by Rabe, Green No. 1554. Our readings on the summit were as follows:

Summit of Mount Whitney, July 8, 1903. Observers: J. N. LeConte and A. G. McAdie.

Pacific time.	Green, No. 1554.		Green, No. 1664.	
	Barometer.	Attached thermometer.	Barometer.	Attached thermometer.
	Inches.	° *F.*	*Inches.*	° *F.*
9:30 a. m.	17.630	51	17.652	54
10:00 a. m.	17.638	51	17.652	55
10:30 a. m.	17.646	55	17.660	55
11:00 a. m.	17.650	55	17.660	54
11:30 a. m.	17.650	50	17.667	52
12:00 noon	17.650	49	17.668	51
12:30 p. m.	17.652	48	17.674	54
1:00 p. m.	17.654	49.5	17.674	53
	17.646 – 0.036*	51.7	17.663 – 0.041*	
	17.610 + 0.088†		17.622 + 0.068†	
	17.698		17.690	

* Reduction to standard temperature.

† Sum total of the probable instrumental error, scale correction, capillarity, and gravity corrections for latitude 37° and for altitude 15,000 feet.

The mean of our pressure readings on the summit was 17.690 inches, while the mean of the Langley readings was 17.588 inches. There are only four of the series by Langley which were taken at hours comparable with ours, namely, September 4, 8:30 a. m.; September 5, 12:40 p. m.; September 6, 8:17 a. m.; and September 6, 9 a. m. The mean of these corrected and reduced is 17.609 inches. The difference, therefore, is but 0.081 of an inch. The temperatures also agree fairly well.

Professor Langley gives the elevation of Mount Whitney as 14,522 feet, or 10,762 feet above his base station at Lone Pine.[2]

We found deposited on the summit a record of an ascent made on August 23, 1902, by Professors Kellogg, Hallock, Putnam, and others, in which it is stated that the temperature was then 34° F., and the boiling point, as determined by Wm. Hallock, 186.4° F. It is interesting to note that the pressure corresponding to this boiling point would be 17.58 inches.

On October 8, 1895, Hutchings and others ascended the mountain and reported that water boiled at 187° F.

WHEELER'S DETERMINATIONS.

Wheeler gives as the height[3] determined by the adopted mean of barometric observations made by the observers of his survey party of 1875, 14,471 feet. The mean of three readings, at half hour intervals, on September 24, 1875, after being corrected and reduced, was 17.796 inches; temperature, 35.3°; wet bulb reading, 29.0°. A similar mean for October 13, 1875, was 17.840 inches; temperature, 36.7°; wet bulb reading, 32.2°. The corrections applied are not accessible, but the records are probably in the office of the Chief of Engineers, U. S. Army.

The record of the observations made by Rabe in 1873, with the barometer, Green No. 1554, is as follows:

Barometer.	Attached thermometer.
Inches.	*° F.*
17.836	33
17.848	42
17.842	38
− 0.015*	
17.827	

These readings, corrected for temperature only, differ from the values obtained by us, by +0.217 inches. The difference from the readings of the other barometer, Green No. 1664, was +0.205 inches. It will be noticed that there is a decrease in temperature during the observations as shown by both attached thermometers, and moreover the temperatures themselves are not similar. Barometer No. 1554 is a small mountain barometer with a scale reading from 24 to 11 inches. Barometer No. 1664 has a scale reading from 33 to 14 inches. Both instruments were filled with clean mercury June 23, 1903, and the longer instrument carefully read and compared with station barometer No. 387 in the Weather Bureau office at San Francisco. Its mean correction was +0.068 inches. It may be questioned whether this correction properly applies to readings at high elevation, but for the present we will assume that it does so.

Simultaneous pressure readings, July 8, 1903.

Hour (Pacific time).	Mount Whitney.	Independence. Elevation 3910 feet.	Mount Tamalpais. Elevation 2375 feet.	San Francisco. Elevation 155 feet.
10 a. m.	17.680	25.965	27.55	29.90
11 a. m.	17.689	25.958	27.56	29.89
12 noon	17.701	25.936	27.56	29.88
1 p. m.	17.704	25.919	27.56	29.86

[2] The exact elevation of the station at Lone Pine is uncertain.

[3] United States Geological Surveys West of the One Hundredth Meridian. Wheeler, 1889, p. 95.

The above are the so-called station pressures, that is, the observed readings corrected for temperature, scale correction, capillarity, and gravity. Independence is the Weather Bureau station nearest to Mount Whitney, and the observations were made at that point by Mr. Charles C. Garrett.

The sea-level pressures at Independence and at San Francisco were as follows:

Hour.	Independence.	San Francisco.
10 a. m.	29.88	30.06
11 a. m.	29.86	30.05
12 noon	29.85	30.04
1 p. m.	29.82	30.02
Mean	29.85	30.04

The observations at San Francisco and at Mount Whitney can be used to determine the elevation of the latter above sea level.

Professor Bigelow's modification of the Laplacian equation, as given on page 490, equation 60, of his report on International Cloud Observations, Vol. II of the Report of the Chief of the United States Weather Bureau, 1898–99, or equation 52, p. 66, of his Report on the Barometry of the United States, etc., Annual Report of the Chief of the United States Weather Bureau, 1900–1901, Vol. II, is as follows:

$$h - h_{\circ} = (56517 + 123.3\theta + 0.003h)$$
$$\left(1 + 0.378 \frac{e}{B}\right)(1 + 0.0026 \cos 2\varphi) \log \frac{B_{\circ}}{B}.$$

Using the values for 10 a. m. July 8, $B_{\circ} = 30.06$ inches, as at San Francisco, $B = 17.680$ inches, as on Mount Whitney, and a mean temperature $\theta = 53°$, we obtain

$$\log B_{\circ} = \log B + \frac{h - h_{\circ}}{56517 + 123.3\,(53) + 0.003h}\left(1 - \beta\right)\left(1 - \gamma\right),$$

whence $h = 63096 \times 0.230507 = 14,515$ feet.[4]

PREVIOUS DETERMINATIONS OF ALTITUDE.

On page 201 of his Researches on Solar Heat (Professional Paper of the Signal Service No. 15), Professor Langley gives what is probably the best series of observations as yet made on Mount Whitney. The observers were Mr. E. O. Michaelis, Mr. J. J. Nanry. and Mr. J. E. Keller.

The readings given in Table 173 of his work are as follows:

Reading of barometer No. 2018, Signal Service, on the summit of Mount Whitney.

Date.	Time.	Reading.	Attached thermometer.	Reading.*
1881.		*Inches.*	*° F.*	*Inches.*
September 2	6:00 p. m.	17.600	30.0	17.599
2	9:00 p. m.	17.597	26.5	17.603
2	12 midn't.	17.569	25.5	17.576
3	3:00 a. m.	17.529	22.5	17.540
3	6:00 a. m.	17.518	22.5	17.529
3	8:15 p. m.	17.514	28.2	17.516
4	8:30 a. m.	17.627	52.8	17.591
5	12:40 p. m.	17.600	62.5	17.546
5	5:07 p. m.	17.680	61.5	17.628
5	6:30 p. m.	17.640	42.0	17.622
5	8:20 p. m.	17.599	38.0	17.588
5	10:22 p. m.	17.558	32.0	17.555
5	12 midn't.	17.558	31.5	17.555
6	1:00 a. m.	17.610	30.0	17.610
6	3:00 a. m.	17.610	30.0	17.610
6	5:00 a. m.	17.610	28.0	17.613
6	8:17 a. m.	17.692	52.0	17.657
6	9:00 a. m.	17.680	54.4	17.640

*Corrected for temperature and reduced to Signal Service standard but not for gravity.

[4] The editor having kindly pointed out that I had not made full use of the Independence readings, I give herewith the following values: 10 a. m., 14,441 feet; 11 a. m., 14,414 feet; noon, 14,378 feet; 1 p. m., 14,355 feet, which, as the editor remarks, are to be considered as only a portion of a continuous 24-hour series.

Having also seen Mr. Heiskell's computations I would add that the values 14,530 and 14,532 obtained by him by using the Bigelow tables agree with the values obtained above in which the value of θ was 53°,

Measurements of the height by angles of elevation and depression between Old Camp Independence, Lone Pine, and the Peak and return, give a result of 14,470 feet.[5] "It is," says Wheeler,[6] "the highest point measured by careful barometric observations within the territory of the United States, except Alaska."

HISTORICAL NOTES.[7]

The mountain was first seen from Mount Brewer by members of the geological survey of California, Brewer, King, and others, in 1864, and named Mount Whitney. On August 18, 1873, John Lucas, C. D. Bigole, and A. H. Johnson, climbed the peak and called it Fisherman's Peak. On September 1, 1873, Clarence King, then in New York, learned that the peak which he had climbed in 1871, now known as Sheep Mountain, Old Mount Whitney, and Mount Corcoran (Bierstadt) lying to the south of Whitney, was not Mount Whitney, and hastening west climbed the right peak September 19, 1873. On September 6, 1873, the mountain was climbed by Carl Rabe, and the first mercurial barometer, Green, No. 1554, carried to the summit. Professor Langley's expedition is well known. He reached Lone Pine on July 24, 1881, and left on September 10 by way of Lone Pine canyon. The journey, in brief, is described in pages 36 to 44, Professional Paper No. 15, Signal Service, published in 1884.

I can not do better than quote Professor Langley's statement given on page 44:

I do not think the Italian Government, in its observatory on Etna, the French, in that of the Puy de Dome, or any other nation at any other occupied station, has a finer site for such a purpose than the United States possess in Whitney and its neighboring peaks; and it is most earnestly to be hoped that something more than a mere ordinary meteorological station will be finally erected here and that the almost unequaled advantages of this site will be developed by the Government.

COMPUTATION OF THE ALTITUDE OF MOUNT WHITNEY.

A report by Mr. H. L. HEISKELL to Prof. F. H. BIGELOW, dated October 2, 1903.

Relative to the observations made on Mount Whitney, Cal., by Professor McAdie on July 8, 1903, at 10 a. m., 11 a. m., noon, and 1 p. m., and used by him in connection with simultaneous observations taken at Independence, San Francisco, and Mount Tamalpais, to determine the height of the summit, I find that the observations are too few, and taken at a bad time of the day, to give any very accurate results.

Three essential elements must be considered in barometric hypsometry: temperature, pressure, and vapor pressure, and the observations should be taken at different times of the day and on different days, so as to obtain a true mean; an error of one degree in mean temperature causes an error of 20 feet in the height of Mount Whitney; an error of .001 of an inch in pressure causes an error of one foot in the computed height. In these observations the attached thermometer is read for temperature and there are no hygrometric observations; then again the temperature at Independence, etc., was taken from the thermograph, so that a possible error of from 100 to 200 feet is not improbable.

From the data available, using your formula in your Barometry Report, I make the height of Mount Whitney as follows:

	Feet.
By using the simultaneous observations taken by the observer at Independence and by Professor McAdie at Mount Whitney, the elevation is	14 651
San Francisco and Mount Whitney	14 532
Mount Tamalpais and Mount Whitney	14 618
Mean	14 600

If we reduce the observations at Independence, San Francisco, and Mount Tamalpais to sea level and then compute to Mount Whitney, we have,

	Feet.
Independence and Mount Whitney	14 590
San Francisco and Mount Whitney	14 532
Mount Tamalpais and Mount Whitney	14 595
Mean	14 572

or a difference of 28 feet from the preceding.

Professor McAdie, using observations taken at San Francisco only, calculates the height as 14 515.

On September 2, 3, 4, 5, and 6, 1881, Professor Langley had a very accurate and careful series of 18 simultaneous observations taken at Lone Pine and Mount Whitney and published in his Researches on Solar Heat. His barometers were carefully compared and his temperature and hygrometer observations were made by experienced observers, so that the accuracy of the work can hardly be questioned. In 1900 Mr. Gannett deduced from railroad levels the elevation of Lone Pine as 3661 feet above sea level, but in 1881 the height of Lone Pine was given by Mr. George Davidson to Professor Langley as 3760 feet, or nearly 100 feet higher. The means of 18 simultaneous observations at the two points are as follows:

Lone Pine.		Mount Whitney.	
Pressure	26.018	Pressure	17.586
Temperature	69.57	Temperature	37.20

Using the height of Lone Pine, as given by Mr Gannett in 1900 (3661 feet), and the barometric observations of Professor Langley, I make the height of Mount Whitney 14,423.

Professor Langley, in his report, using 3883 feet for Lone Pine and his own barometric work, says Mount Whitney, by barometer observations, is 14,625.

Professor Langley, by using Davidson's altitude, 3760 feet, for Lone Pine and barometer observations at Mount Whitney, makes the height 14,522.

On August 17 to September 7, 1881, Professor Langley had 16 simultaneous observations taken at Lone Pine and Mountain Camp to determine the height of the camp; to see how we agree on that height I herewith give the data:

Using Davidson's height of Lone Pine, 3760 feet, the height of Mountain Camp is 11,624.

Using Gannett's height of Lone Pine, 3661 feet, Mountain Camp is 11,525.

Professor Langley makes Mountain Camp 11,625.

From the above, I should say that the approximate heights are:

Lone Pine, Gannett, 3661.

Mountain Camp, Gannett and Langley, reduced by me, 11,525.

Mount Whitney, Gannett and Langley, reduced by me, 14,423.

I should, therefore, suggest that the adopted height of Mount Whitney be about 14,423 feet, as determined by using Professor Langley's observations and Professor Gannett's height in 1900 for Lone Pine.[1]

or a degree less than that used by him. Recomputing the elevation, but using a temperature of 54° and sea-level pressure of 30.06 my computation gives 14,572. The sea-level pressure used by Mr. Heiskell was 30.04 inches and the station pressures 17.694, which, according to the method of computation used above, would give an elevation of 14,534 feet.—A. M., November 20, 1903.

[5] But this depends upon the height of Lone Pine depot; and this in turn upon the elevation of Mound House on the Virginia and Truckee Railroad.

[6] Quoted above.

[7] References: Langley—Researches on Solar Heat. Wheeler—Surveys West of One Hundredth Meridian, 1889. Steuart—Mount Whitney Club, Visalia, Cal. LeConte—Sierra Club Bulletin.

[1] A letter from Professor McAdie makes it very doubtful whether the hamlet "Lone Pine," occupied by Professor Langley, in 1881, is the same as the railroad station "Lone Pine," subsequently established. Other letters will be found on page 533.—ED.

METEOROLOGICAL RECORD AT ORONO, ME.

By Prof. JAMES S. STEVENS, dated November 23, 1903.

From January 1, 1869, to January 1, 1893, a series of meteorological records was kept at Orono, Me., by Dr. M. C. Fernald, ex-president and sometime professor of physics at the University of Maine. The observations included three records daily of temperature, relative humidity, maximum and minimum temperature, air pressure, cloudiness, and wind direction and force. These were taken at 7 a. m. and 2 and 9 p. m. local time.

The latitude of the place of observation is 44° 54′ 2″ north; longitude 68° 40′ 11″ west, and height above sea level 115 feet.

These results have not been published heretofore and it was thought that their presentation here might be of general interest, and that some of the results might prove of more than passing value.

Considering first the observations relating to temperature, we note the following:

	°
Mean of warmest day, August 7, 1876	85.3
Mean of coldest day, January 8, 187 .8	—17.2
Absolute highest temperature, August 31, 1876	96.7
Absolute lowest temperature, December 31, 1890	—36.3
Mean of maximum temperatures	51.26
Mean of minimnm temperatures	33.68
Mean of the mean maximum and minimum temperatures	42.47
Mean of three daily readings for the same period	42.48

The agreement between the last two numbers in the above list is remarkable. So far as these observations go, the average of the maxima and minima is essentially the same as the average of three daily readings when carried through a sufficiently prolonged period. Taking the records for each separate month of the twenty-four years it is found that about once a year the mean from the maximum and minimum differ from that of three daily readings by as much as one degree.

A striking result is obtained if we take the mean of the mean daily temperature for each month of the period under consideration, and then in turn take the mean of the months which differ by six. This is shown, as follows:

Mean temperature for twenty-four years.

Month.	Mean.	Month.	Mean.	Mean of both.
	°		°	°
January	16.09	July	67.40	41.75
February	19.21	August	65.54	42.38
March	27.31	September	57.51	42.41
April	40.19	October	45.81	43.00
May	52.51	November	34.12	43.32
June	62.41	December	25.57	41.99
Average	36.29	Average	48.66	42.48

Comparing these results with the mean temperature for the whole period (42.48°), we observe that in no case does the mean of the pairs of months considered differ by as much as one degree therefrom. It is hoped that other observers who have recorded the data for long periods will apply this test.

The mean temperature for each month shows that the maximum occurred in July, 67.40°, and the minimum in January, 16.09°. This latter is contrary to the prevailing opinion regarding Maine temperature, as February is generally regarded as the coldest month. When the monthly means are plotted the curve has the general characteristics of curves of this class plotted by other observers. See, for example, Loomis's Treatise on Meteorology, p. 31, where is plotted a like curve for New Haven, covering a period of eighty-six years. The similarity of the two curves is striking.

During the period in question the total annual rainfall averaged 36.00 inches and the snowfall 94.43 inches, making the average annual precipitation 45.44 inches, or 3.79 inches per month.[1]

The mean percentage of cloudiness for the twenty-four years was 52. The direction and force of the wind, recorded in accordance with the instructions of the United States Weather Bureau, resulted as follows: Northwest and west, 40 per cent; southwest and south, 28 per cent; northeast and north, 20 per cent; southeast and south, 12 per cent.

The maximum barometric pressure reduced to 32° F. was 30.833 inches; the minimum, 28.423 inches; and the mean, 29.842 inches. The correction for gravity is inappreciable.

The mean pressure of vapor for fifteen years (1869–1884) was 0.257 inches of mercury.

The relative humidity ranged from a maximum of 100 per cent to a minimum of 10 per cent, with a mean for the 24-year period of 77 per cent.

The number of thunderstorms observed[2] during the period was as follows:

Year.	No.	Year.	No.
1870	7	1882	12
1871	5	1883	12
1872	10	1884	10
1873	4	1885	13
1874	4	1886	13
1875	6	1887	11
1876	4	1888	12
1877	7	1889	11
1878	9	1890	10
1879	12	1891	13
1880	9	1892	8
1881	13		

When these numbers are plotted there seem to exist periods of maxima and minima of thunderstorms.

MOUNTAIN AND VALLEY BREEZES.

By Mr. W. S. TOWER, Assistant in Meteorology in Harvard University, dated Cambridge, November 17, 1903.

It is a well-known fact that mountains and valleys have certain phenomena that are peculiarly their own. Probably the best known of these are mountain and valley breezes.

Because of active radiation at night the layers of air near the earth become cooled, hence heavy, and tend to move down hill. This tendency soon results in a general down-valley movement of the lower strata, producing a perceptible breeze. This is the so-called mountain breeze. During the day, the presence of warmer, therefore lighter air near the earth, causes a general movement up the valley slope, and also gives a sensible breeze. This is the valley breeze.

While in the Needle Mountains of southwestern Colorado during the past summer, with the Harvard University class in Rocky Mountain geology, I had an opportunity to see these phenomena under favorable conditions. In all the valleys of these mountains, and particularly in the side valleys of the Rio de las Animas canyon, this system of winds was very marked. Each valley had its own separate wind. That is, during the day, in a west draining valley there was a west wind, but in a nearby east draining valley an east wind, so that in passing from one such valley to the other a reversal of wind direction was experienced.

The duration of each wind seemed to depend almost entirely on the time that the sun entered the valley in the morning and left it at night; or in other words, it was dependent on the time when nocturnal cooling ceased and diurnal warming began and vice versa. But though the hours of duration for either wind varied because of local topography, and from day to day, according to general atmospheric conditions, the average hours remained fairly constant. Thus, in this particular region the valley wind ordinarily prevailed from 8 or 9 a. m. until 6 or 7 p. m., and the mountain wind from 8 or 9 p. m. until 6 or 7 a. m., leaving between the two winds a transitional period of relative calm.

In the case of two valleys heading together, there is, as we

[1] It can not be too strongly urged that observers measure both depth of snowfall and equivalent melted snow water; the use of the ratio 10 is only allowable in extreme necessity.—ED.

[2] Actually experienced at this station.

have seen during the daytime, a condition of two opposing winds blowing toward each other. What is the result? No observations were obtained at the time which would explain this point. However, Hann[1] says that the daytime wind from the deeper valley, resulting from the warming of a greater body of air, will cross the dividing line and blow down the shallower valley. To support this he cites the case of the Inn and the Maira rivers, where the day wind from the deep valley of the latter extends over the pass separating the two and gives a down-valley wind along the headwaters of the Inn. Under similar conditions, it is probable that the same phenomena can be found in this country.

Although both these mountain and valley winds, as observed in Colorado, were very constant in their daily recurrence, they were entirely interrupted by a cyclonic disturbance, and somewhat modified during spells of general cloudiness.

The passage of thunderstorms across a valley showed still more marked control over the breezes. While in the neighborhood of Durango, in the Animas Valley, which runs north and south at this point, the movement of a thunderstorm across the valley to the south of the observer entirely reversed the wind direction, so that during the passage of the storm the wind blew down the valley from the north, instead of up the valley from the south. In this particular case the reversal of wind direction resulted in a change from a warm south wind to a cool north wind, and back to south again, all in the space of less than twenty minutes. But the passage of a storm across the valley to the north of the observer was seen later to have no effect upon the wind beyond a slight increase in velocity.

No such interruptions were observed in the case of mountain breezes, but it is reasonable to suppose that they do occur, the more so because mountain breezes are as a rule weaker than valley breezes. The cause of the interruption lies plainly enough in the radial circulation of air around the storm center.

In a single instance one other modification of the valley wind was observed. Near the head of Ten Mile Creek, a tributary of the Animas some five miles above Needleton, the valley bottom is occupied by Balsam Lake, about one-half mile long by one-quarter of a mile wide. This lake is at an elevation of about 11,450 feet; is fed by streams running from melting snow fields, and had, during the week of our stay there, a maximum temperature of about 45° F. During the day, therefore, the water was much cooler, often more than 25° cooler, than the air in the surrounding valley. In a small gorge at the outlet of this lake in the afternoon I observed a feeble wind blowing out from the water surface, that is, down valley, in direct opposition to the general valley wind. Though this contrary wind was perceptible for only a short distance from the lake, its occurrence is easily explained, and it seems probable that more observations would indicate a general interruption of both valley and mountain breezes.

[1] Hann, J. "Lehrbuch der Meteorologie," p. 439 and Z. O. G. M., 1885, Vol. XX, p. 139.

WATERSPOUTS AT CAPE MAY, N. J., AUGUST 24, 1902.

By Dr. C. Fontaine Maury Leidy, dated Philadelphia, September 5, 1902.

Because of the great interest and comparative rarity of waterspouts, I report as an eyewitness a most interesting storm which occurred off Cape May, August 24, 1902, at 10:30 a. m. Looking out to sea, about 1 mile, slightly west of a line, from the center of the town to Cape Henlopen light, there was a dense black, overhanging cloud; from its south edge there hung a black column, perpendicularly to the ocean, the base was enveloped in a dense cloudy steam-like mist. The extreme end entered directly into the densest part of the cloud. The sides of the column were parallel, and it seemed to be of the same density from top to bottom and from side to side. The accompanying cut[1] gives a most accurate view as it was in reality. One curious feature of this dense cloud was that it seemed to be absolutely alone. Surrounding clouds were few, and none other so dense. From the rapidity with which it enlarged there was not the slightest doubt but that it was fed from this enormous waterspout. Shortly after the first column faded away, the base seemingly enveloped in steam, about 200 yards distant another column formed, apparently suddenly, the first column remaining only in the form of a pedicle, appearing to hang from the clouds, about one-fourth the original length. About 400 yards to the left another column appeared, at no time was there more than one complete column, the others fading away and then returning. The first column almost entirely disappeared, but returned more dense than ever before, with the total disappearance of the other two waterspouts; they continued for fully forty minutes in almost the same location.

There was a heavy depressing feeling in the atmosphere. The tide was high at about 11 a. m.; it was unusually high at this hour. The wind was increasing but the sea was unusually calm but choppy in the course of the storm.

Living directly on the beach, I saw almost over the back buildings of the house, so low that one could have easily thrown a ball into the mass, an enormous bottle-shaped cloud, white and dense, hanging from the cloud, with the neck pointing toward the earth. It appeared to be 8 to 9 feet long and about 4 feet in diameter. Shortly the neck became greatly elongated and 8 or 10 feet of tubing seemed to protrude. During this change there was considerable wind, with enormous drops of rain, the largest I have ever seen. This mass crossed the edge of the house, there being great disturbance in the wind but not until it reached the beach was there noticed any circular or spiral movements. The first object met was a small dog which endeavored to return home but was lifted off his fore feet and turned around and around in the direction of the hands of a clock. Not once was this poor frightened animal able to regain his feet until he managed to get so far into the outskirts of the whirlwind as to regain all four feet and run away. The next object was a large "A" tent which, though very securely pinned down, was lifted up and and torn completely off the staples excepting one fastening; the tent twirled round and round and remained suspended perpendicularly in the air for several minutes, the whirlwind passing over it finally. As the sand was reached we saw the dense mass drawn up into a cylindrical shape which quickly passed to the breakers, and when there almost as though a curtain was raised, the waterspout appeared from the base upward. The column was dense and black, the base enveloped in mist; there was no distinct rotary direction but the choppy sea was twirled and seemed to flow in all directions. During the formation of this last column there was considerable rain but no hail, although the size and force with which the enormous drops struck caused one to stop and look for hail. There was very little thunder and lightning. The disturbance remained in the water possibly fifteen minutes after the disappearance of the waterspouts. At one time there were four individual waterspouts to be seen, but only one entirely perfect at any one time; the other three merely formed the pedicles which hung from the cloud. The first column remained on and off for more than half an hour. The last one remained not more than eight to ten minutes.

[1] The cut here referred to was a half tone reproduction of an admirable photograph taken by an unknown local artist, representing the third of the series of waterspouts. After some delay a copy of this photograph was obtained, but in the mean time the original negative seems to have been altered by the addition of lines that destroy its value for meteorological study, and we have, therefore, with much regret, decided not to reproduce it.—ED.

NOTES AND EXTRACTS.

WEATHER BUREAU MEN AS INSTRUCTORS.

Mr. Norman B. Conger, Inspector, Weather Bureau, reports a short address by himself on Weather Bureau warnings and their use, delivered in Detroit, Mich., November 30, under the auspices of the Educational Committee of the North Woodward Methodist Church.

Mr. Weston M. Fulton, Local Forecaster at Knoxville, Tenn., delivered an illustrated lecture on meteorology in the auditorium at Chattanooga, Tenn., on December 23. Mr. L. M. Pindell, Observer in charge at Chattanooga, was successful in arousing the enthusiastic support of the business men and public-spirited citizens of Chattanooga, who guaranteed to bear all the expense of this free lecture for the benefit of the community at large. In accordance with the general policy of the Department of Agriculture, Mr. Fulton was granted leave of absence from his station for the purpose of delivering the lecture. Mr. Pindell has established a department of meteorology as one of the courses of education in the high school, which is proving very popular. A library of 75 volumes on meteorology has been provided and money for the purchase of instruments has been raised by popular subscription.

Mr. Frank P. Chaffee, Section Director at Montgomery, Ala., reports that he lectured in that city on November 18 before 4 teachers and 120 pupils of the Girl's High School. The lecture, which was on "The Atmosphere, its Elements and Movements, with Particular Attention to the Laws of Storms," was illustrated with blackboard drawings and printed climatic charts.

As a result of the lecture, the weather maps issued by his office will be taken up as a regular class study in connection with that of physical geography.

CLIMATOLOGY OF CALIFORNIA.

Under the above title the Weather Bureau has published a memoir by Prof. Alexander G. McAdie, to be known as Bulletin L, of the quarto series, or W. B. No. 292. Besides the large amount of material compiled by himself, a number of special chapters have been written by Weather Bureau officials, e. g.: The climate of Los Angeles, by Mr. George E. Franklin; Sacramento, by Mr. James A. Barwick; San Diego, by Mr. Ford A. Carpenter; Red Bluff, by Mr. Maurice Connell; Eureka, by Mr. Aaron H. Bell; Fresno, by Mr. J. P. Bolton; San Luis Obispo, by Mr. J. R. Williams; Independence, by Mr. J. J. McLean. A number of other acknowledgments are made, among them the contribution of the Rainfall Data at High Stations, by Mr. J. B. Lippincott, Hydrographer of the United States Geological Survey. In his opening chapter Professor McAdie enumerates the four controlling factors on which the climate of California depends:

1. The locations and changes of both the permanent areas of high and low pressure and the smaller individual areas of pressure.
2. The prevailing drift of the atmosphere from west to east.
3. The proximity of the Pacific Ocean, considered as a natural reservoir of heat.
4. The exceedingly diversified topography for a distance of 200 miles east of the coast line.

Under these heads a considerable amount of data is given. The corrected table of altitudes and locations of all summits exceeding a thousand meters in altitude will doubtless often be referred to. The chapters relating to the climate of the north and central coast, the southern coast, the Great Valley, and the Santa Clara Valley consist essentially of tabular data, showing the mean temperature, the minimum and maximum temperatures, and the rainfall, and in some cases all the other climatological data, month by month, for each year since the beginning of meteorological records. Similar tables are then given for individual stations in the section of local climatology. The last page of this section is devoted to the minimum winter temperatures recorded on the summit of Mount Lyell (13,041 feet altitude). On July 8, 1897, a minimum thermometer was left upon the summit, inclosed in a thin wooden box about 6 inches square and 2 feet long. This was visited on June 5, 1898, and again in July, 1899. The minimum readings were —13.6° F., or —25.3° C., for the winter of 1897–8, and —17.6° F., or —27.6° C., for the winter of 1898–9. Professor McAdie compares those with the corresponding minimum temperatures observed at Bodie, a few miles to the east and at an elevation of 8248 feet, where the minimum temperatures were —24° F. and —30° F.

The third section of Bulletin L, or pages 168–213, consists entirely of tables of monthly and annual precipitation. One hundred and thirty-three stations are included in this collection, which are additional to those printed in the previous part of the book. We think the students of climatology will regret that in these and similar tables, the observations by different observers at neighboring localities, with different instruments, are combined together into one continuous series without any indication as to where the individual component series begin and end, thus preventing any attempt at reducing the components to a homogeneous system. The next portion of the volume, pages 215–255 is devoted to snowfall, frosts, and fog. The snowfall is given for each month for the years 1878–1900 for 4 stations, Boca, Emigrant Gap, Summit, and Truckee, and for many other stations for shorter periods. The very heavy snowfall recorded for the winter months shows that a slightly higher elevation would almost certainly give rise to a permanent glaciation of the summits of this portion of the Sierras. The article on fog is illustrated by a number of striking photographs of cloud and fog views that Professor McAdie succeeded in taking from the summit of Mount Tamalpais. The volume concludes with short chapters on the thunderstorms and earthquakes recorded in California. It seems that though lightning is rare in California lowlands, yet is common enough on the Sierras. The whole volume of 270 pages must be recognized as a valuable collection of data and a monument to the intellectual activity of Professor McAdie and his staff of colaborers.

PROPOSED PILOT CHARTS OF THE SOUTH ATLANTIC AND OF THE SOUTH PACIFIC OCEANS.

According to a notice published on the Pilot Chart for January, 1904, the United States Hydrographic Office has in view the publication of meteorological charts of the South Atlantic and of the South Pacific oceans, similar in scope to the present monthly Pilot Charts of the North Atlantic and North Pacific oceans.

The proposed charts will be published quarterly instead of monthly, the first to appear being the chart of the South Atlantic Ocean for its winter months of 1904. It is hoped to have this ready for distribution June 1, 1904.

Successive seasonal charts of the South Atlantic Ocean will appear at quarterly intervals until the entire year has been included, after which a like series will be taken up for the South Pacific Ocean.

The United States Hydrograpic Office earnestly requests the cooperation of mariners navigating these waters in the preparation of these charts. The assistance of masters of sailing

vessels is especially desired. Blank forms for meteorological observations, with instructions for taking the same, will be furnished upon application either by mail or in person to the Hydrograper, United States Hydrographic Office, Navy Department, Washington, D. C., or to any one of the branch offices.

The charts will be furnished free of charge to cooperating observers, irrespective of nationality.

The charts contemplated in the above notice will be gladly welcomed by meteorologists, who necessarily study the whole globe rather than any one small section. Of course they will at first be made up largely from the normal data already accessible, but after a few years the accumulated publications of current data will constitute a very important and convenient addition to our limited knowledge of the Southern Hemisphere. It is to be hoped that the whole Southern Hemisphere is to be included in the two charts entitled South Atlantic and South Pacific oceans. It certainly would be a great pity to omit the South Indian Ocean.

A DAILY WEATHER MAP FOR THE NORTHERN AND SOUTHERN HEMISPHERES.

In a recent letter from Sir John Eliot, Meteorological Reporter to the government of India and Director-General of Indian Observatories, he says:

Meteorology is a question of thermodynamics and aerodynamics. There are probably some general relations between sun spots and terrestrial magnetism and some of the broader and most general features of terrestrial meteorology. They can, however, only be of use as indications of large local variations of weather (such as are experienced in India) after we have investigated the problems from the hydrodynamical side, or as questions of variations of air movement depending upon variations of absorption of solar radiant energy, etc.

When I was in England recently, Sir Norman Lockyer, Mr. W. N. Shaw (the head of the Meteorological Office), and myself discussed the possibility of a daily weather report and chart of the British Empire. It is quite in the air at present, but I have already consulted the government of India and the present authorities fully sympathize and would be prepared to do their share. Perhaps if the United States and England joined hands in this, it might eventually lead to the world map which you suggest.

THE METEOROLOGICAL OBSERVATORY AT SAN FERNANDO, SPAIN.

A letter of October 15, 1903, announces that by royal decree of August 20, Captain Fuenoy de Azearote has been appointed director of the Marine Institute and Observatory at San Fernando, in the Province of Cadiz, Spain. This institution was established in 1753 by King Iorge Juan. It was then located at Cadiz, but was transferred to San Fernando at the beginning of the 19th century. It is at present conducted under the regulations laid down in 1873. It publishes a nautical almanac for the use of Spanish navigators, and a volume of astronomical, magnetic, and meteorological observations, and also examines the nautical instruments used by the Spanish Navy for the purpose of detecting errors.

EDUCATION OF METEOROLOGISTS.

The gradual development of meteorology has for two hundred years been due to the activity and faithfulness of innumerable observers throughout the world and it has not been supposed that the labor of reading instruments and making weather records required anything but ordinary intelligence, good habits, and perseverance on the part of the observers. Those who have tried to penetrate the laws of atmospheric phenomena generally found the problems too difficult and very few profound theories have, as yet, been accepted as satisfactory to the best students. At the present time, however, the so-called practical man is being very hard pushed in order to keep abreast with the progress that is being made by a new race of investigators who are applying to the atmosphere the best that is now known relative to all the laws of physics and mechanics. It will no longer do to say that the practical man is ahead of the theoretical or that the college graduate is inferior to one who is not a collegian. Whatever advance may be made in the practical business operations of the thirty or forty national weather bureaus now in existence; however much they may extend the telegraphic work, and the areas covered by the daily weather maps, or the accuracy and minuteness of the daily weather forecasts, yet, there will always be use for those who are delving deeper and searching further. There is a divine instinct that leads men to strive upward and forward in the realm of knowledge. We are confident that everything is governed by law and that these laws are not beyond our knowledge. Little by little we shall dissipate the ignorance around us; we shall unveil the arcana of the universe; we shall find the work of the observer confirming our theories; we shall honor those leaders of science whose fancies have not led them astray in their efforts to discover the laws of nature.

An article by Prof. Edwin G. Dexter, published not long since in the "Popular Science Monthly," shows very clearly that the high grade college graduates also attain a high grade in subsequent practical life in the world at large. He concludes by saying:

The statistical evidences that the high grade man maintains his status in after life, which are here presented, though open to all the criticisms of the statistical method are nevertheless in accord with our general belief of what should be. If the college course is a true preparation for life, it is but natural to expect that he who best fulfils the requirements of the former is best fitted for the latter. Were this not so we should pronounce the preparation a failure.

May we not add that if education is good for the business man it may also be good for the meteorological observer. Shall we not make better observers in proportion as we study meteorology more thoroughly and learn to appreciate all the fine points that have been brought out by centuries of records and studies? Shall we not make better climatologists by having regard to the rules that govern the legitimate methods of studying statistics, rules that are as rigid as the laws of chance or the play of roulette or cards at the gaming table? Shall we not make better meteorologists by familiarizing ourselves with the laws of physics that pervade the whole atmosphere. The winds and clouds, heat and cold, rain, storm, and drought can not vary, except in obedience to the laws of nature.

COOPERATION IN GOVERNMENT WORK IN SCIENCE.

In its issue of April 16, 1903, Nature, London, prints in full the resolutions recently promulgated by the government of India, with the purpose of so directing the energies of the various departments as to promote an effective cooperation and prevent useless duplication in scientific work.

Steps in this direction were taken six years ago, when the policy of the government in establishing departments of scientific research was clearly set forth and the desirability of coordinating the labors of the different departments was pointed out. The broadening and development of scientific work in pursuance of the policy then outlined has but served to emphasize the necessity of the cooperation suggested at that time.

The work of many members of the scientific staff covers fields in which experiments of a similar or cognate character are being independently conducted. Thus in chemistry we have several investigators following parallel lines of research; in economic botany there are two departments working independently of each other; in economic entomology there have been two specialists, each charged with investigations similar to character.

It is therefore proposed to appoint a board of scientific advisors, which will review and advise generally upon the work of the departments, and will endeavor, not only to effect such consolidation as may be expedient, but also to direct the sci-

entific work of the government along practical lines. The board will consist of the heads of ten scientific departments, "together with such other scientific authorities as may from time to time be invited by the government of India to serve upon it." The Secretary of Revenue and Agriculture, who is the official head of the departments represented, will be ex-officio president of the board. It is the function of this body to—

Annually receive and discuss the proposals of each departmental head in regard to the programme for investigation in his department. In cases where interdepartmental cooperation is necessary, it will rest with the board to advise as to the lines on which mutual assistance should be given and the department to which the inquiry should primarily appertain. Where the proposed investigation falls exclusively within the domain of a particular department, the function of the board will be confined to examining and criticising the proposals. It is not intended that the directing influence of the board should, in any way, weaken departmental executive control or responsibility, and the precise manner in which, and the agency by which, any required information is to be collected or investigation carried out must be left to the heads of the deparments concerned. The board will submit annually to the government a general programme of research which will embody the proposals of departmental heads in so far as its subjects are to be exclusively dealt with in one department, and its own proposals in cases where two or more departments are to cooperate.

This experiment should be observed with great interest in this country, where a duplication of work exists, not only between different departments, but, in some cases, between different bureaus of the same department. Cooperation or consolidation has at times been suggested. Perhaps the chief obstacle lies in the fact that works apparently identical may be prosecuted for such different purposes as to necessitate an essential difference in the details of their execution. Thus the departments of Agriculture, War, and Interior are all three engaged in measuring the heights of rivers, but for different purposes, and no one of the three could depend entirely for this work upon either of the others. Or again, the bureaus of statistics, soils, weather, crops, irrigation are all interested in rainfall, but the Weather Bureau alone is expected to gather and publish the precipitation data. However, as each bureau needs a record of observations prepared in the special manner best fitted for use in its own studies, it would seem wise to have a board representing these five bureaus devise some system of work that will harmonize the various requirements and save any unnecessary labor. Some years ago similar committees, representing several departments and bureaus, did good work in reference to seismology and magnetism, respectively. Why may not suitable departmental committees be more frequently appointed as occasion arises? The board of scientific advisers for India appointed by the governor and council includes 10 persons, representing every branch of government work in applied science.

AQUEOUS VAPOR LINES OF THE SOLAR SPECTRUM.

A general method of determining the total quantity of moisture in the whole atmosphere or any large portion of it has long been a desideratum in meteorology. It is probable that the colors of the sky are due to the action of the mixture of gases and vapors; a comparatively few molecules make a a particle that affects the transmitted waves, both as to their intensity, their wave length, and their planes of vibration. Larger groups of particles of moisture, such as form mist and fog, give rise to the colored rings known as glories and anthelia; larger groups form fog bows and halos and the still larger raindrops form rainbows. Our ordinary pyschrometric observations tell us of the tension and amount of atmospheric vapor, properly so called, but nothing of the condensed moisture; they tell us of the vapor that is near us, but nothing of that which is far away, and especially nothing of what is in the upper strata. Observations of sky color and of the polarization of the blue skylight tell us of the presence of the smallest particles, but not much as to their absolute size or quantity. Quantitative measurements of the general intensity of the light or heat received from any source may be made to tell us the sum total of the effects of absorption by gases and vapors and of reflection or dispersion by small particles of water or dust; but they do not separate the effect of absorption from that of reflection. Finally, quantitative measurements of the intensity of special wave lengths, when observed visually, may give us the effect of the absorption proper. Twenty years ago the observation of the dark band was thought sufficient, but we may also confine ourselves to the observation of specific moisture lines in the spectrum, and they may be observed either visually, bolometrically, or photographically. The visual method was quite thoroughly carried out by Mr. L. E. Jewell, of Johns Hopkins University, in 1892 and 1893, and the results were published in Weather Bureau Bulletin No. 16. The bolometric method has been developed by Professor Langley and has given excellent results; an equivalent thermoelectric method has been developed by Ångström. The photographic method of recording the location and intensity of the atmospheric lines in the solar spectrum has recently been developed by Prof. E. C. Pickering, Director of the Harvard College Observatory. This depends upon the measurement of the widths (as being synonymous with the intensity) of the photographs of the dark lines in the spectrum, and is described in Circular No. 72 of that observatory; the results of the first year's work, are given in volume 48 (1903) of the Annals of the Observatory. To begin with, photographs of the spectra of the sun are taken when the latter is at various altitudes. Each line in the spectrum has its width measured; some of these are found to grow broader and darker in proportion as the sun stands nearer the horizon. These are the atmospheric lines, due to absorption in the earth's atmosphere. Others do not appreciably vary, and these are due to absorption in the sun's atmosphere. Some vary with the amount of moisture in the air and are due to absorption by it. By comparing the intensities or widths of an atmospheric line, as photographed when the sun is high and when it is low, with the corresponding computed thicknesses of the layer of air, it appears that there is an outstanding variation, due to the moisture in the air, namely, according as it is dry or moist. Professor Pickering collates the observations of the atmospheric moisture lines, namely, wave lengths 6267.8, 6273.7, 6276.6, 6282.1, 6293.2, 6305.5, all of which are near the alpha line. These were photographed on 16 different plates by Higgs at altitudes varying from 1° to 49°, for which the path of the beam of light varied between 18 and 0.3. The intensity of the six dark lines, and especially of the average of all, increased steadily with the decrease in the sun's altitude, except only for two cases where the atmosphere was unusually dry. The computation for low altitudes give very constant results from different photographs taken on different days, and Professor Pickering concludes:

It, therefore, appears that the total moisture in the atmosphere along the line of sight can be determined more accurately by this method than by any other as yet proposed.

This conclusion is fully confirmed by the laborious work of Mr. Jewell above referred to. Possibly the bolographic method may yet surpass both the visual and the photographic.

SEICHES IN LAKE GARDA.

Dr. J. Valentin has published in the Anzeiger or early notes of the memoirs presented to the Academy of Sciences in Vienna, a preliminary report on the periodic variations, commonly known as seiches, in the level of Lake Garda, as observed at Riva. The length of Lake Garda, from Riva at the north to Desenzano at the south, is about 52 kilometers; the maximum depth of the lake is 346 meters; the mean depth is 136.1 meters, and the altitude above sea level is 65 meters. From

these data, it results that the duration of one oscillation should be 47.45 minutes, as computed by the formula $T=\frac{2\ L}{\sqrt{gh}}$ where L is the length, h is the depth, and g the force of gravity, = 9.80596 meters. On the other hand, the arms at the southern end of the lake are not likely to take active part in the oscillation of the general mass, and Dr. Valentin thinks it more proper that we should omit their consideration, and adopt 165.6 meters as the mean depth of the remaining portion of the lake, whereby the computed period of oscillation becomes 43.01 minutes. Besides these simple or uninodal oscillations there are also observed binodal and even polynodal oscillations. The former are rather longer than one half of the principle oscillation, so that in general 19 binodal periods are synchronous with 10 uninodal, whence each one has a duration of 22.6 minutes. Oscillations of about 30 minutes and 15 minutes duration, that is to say two-thirds and one-third of the principle oscillation, sometimes occur in connection with the longer or single oscillation. At the north end of the lake, the 30-minute seiche combines with the 43-minute seiche after a short time, while at the south end of the lake the uninodal seiche is maintained pure and simple. The 15-minute seiche, as well as the 30-minute, undoubtedly originates in attempts at oscillations perpendicular to the axis of the lake. In general, the oscillations in the surface of Lake Garda show not only periods that are multiples of the principle seiche, but also the first and second octaves and the two-thirds and one-third of the fundamental period corresponding to the first and second quint or fifth above the fundamental note in music. The analogy between the oscillations of lakes and of the tones of musical instruments is thus quite complete, since the fifth and upper fifth occur most frequently next after the octaves.

A record by the limnograph maintained by Valentin at Riva must be compared with the record of the Italian observers in the southern part of the lake before we can completely elucidate all the peculiarities of its oscillations. The result of the first four months of registration at Riva was sufficient to show that the average duration of the uninodal oscillations was 42.99 minutes, and the amplitude was on the average 20 or 30 millimeters, but had twice attained to 60 or 70 millimeters.

Dr. Valentin gives no suggestion as to the origin of these seiches, but it has been generally recognized that although sometimes due to earthquakes they are most frequently initiated by sudden blasts of wind or changes in barometric pressure.

COPIES OF PROFESSOR VERY'S MEMOIR ON ATMOSPHERIC RADIATION.

A memoir under the above title was published by the Weather Bureau as Bulletin G, serial number W. B. No. 221, Washington, 1900. There has recently been a call for a few copies of this bulletin, and, as the edition is entirely exhausted, the Editor would be glad to hear from any one who is willing to dispose of his copy.

EXTREMES OF TEMPERATURE AND PRESSURE IN MONTANA.

On November 18, Mr. C. W. Ling, Assistant Observer, Havre, Mont., reported:

The weather that has prevailed so far this month has produced record breakers both in the temperature and the atmospheric pressure for the month of November. The first and second days of the month were the *warmest* November days on record at this station for a period of twenty-four years. The high atmospheric pressure that prevailed on the 17th instant made an actual barometric reading of 28.09 inches and a reduced reading of 31.03 inches at 12 noon, which is the *highest* November reading on record here.

The minimum temperature this morning, —29°, was, with but two exceptions, the *coldest* on record here for the second decade of November.

COMPUTATION OF THE ALTITUDE OF MOUNT WHITNEY.

(See page 524.)

Under date of January 11, 1904, Prof. Joseph N. LeConte, of the University of California, says:

The Lone Pine railroad station is on the main line of the Carson and Colorado Railroad, and is on the eastern side of Owens River, close to the base of the Inyo Range. The town of Lone Pine is on the western side of the valley and on the western side of the river also. The distance between the two points is about three miles, and the railroad station bears about north 60° east of the town. I visited the railroad station last September and spent some time with Mr. McGrath, the division superintendent. His memory of the altitude of the rail at the station, namely, 3658 feet, was afterward corroborated in a letter from him to me after consulting the records of the survey at Carson City, Nev. Mr. Henry Gannett gives the same number in his directory of altitudes, evidently obtained from the same source. This, however, is not the altitude of the point occupied by Professor Langley in his determination of the height of Mount Whitney. There has never, to my knowledge, been a line of levels run between the two places, and the only determination of the height of the town that I have ever found is the one given by Captain Wheeler, namely, 3810 feet; this, however, is barometric.

There is a "railroad tangent" at Lone Pine station over 20 miles long. It is absolutely straight and nearly level. It would be easy to measure off a base line four or five miles long, and arrive at a good measure of the elevation of the mountain; this might be still further improved by simultaneous angles observed from the mountain and the station. Such a measurement would depend on the elevation of the rail, of course, but this I think can be checked up. A survey has been run from this point to Mojave on the line of the Southern Pacific near Los Angeles. If the results of this latter survey could be obtained, we would know better how much reliance to put on the figures 3658. It has long been a desire of mine to make this triangulation, for the angle of elevation is over 6° and the distance 15 miles only. But I could not put very much faith on the levels over 550 miles of such rough country.

Under date of January 16, 1904, the Director of the United States Geological Survey, says:

Regarding the relative elevation of the railway station near Lone Pine, Cal., and the barometric station in that town occupied by Professor Langley, the only information that I have been able to get is to the effect that the difference in elevation is slight, probably not exceeding 10 feet, the site of the town being the higher.

More to the purpose, however, is the fact that this office has run a line of levels from the sea through the San Joaquin Valley, and up the south fork of the Kaweah River to Farewell Gap, thence connecting by vertical angles with the summit of Mount Whitney obtaining, as a result, 14,434 feet. I do not consider this result as conclusive, inasmuch as the last link in the chain consists of a single vertical angle at a distance of 34 miles.

METEOROLOGY IN THE UNIVERSITIES AND NORMAL SCHOOLS.

We are pleased to note that the State University of Iowa, in its calendar for May, 1903, announces, on page 171, a course of lectures on meteorology, twice a week through one semester, by Prof. A. A. Veblen, the professor and head of the department of physics. In addition to this course, which is open to both undergraduates and graduates in the department of physics, the university requires for admission the general knowledge of meteorology contained in works on physical geography mentioned on pages 80–81 of the calendar, many of which have already been noticed in the MONTHLY WEATHER REVIEW. This is one of the few universities in the world that recognizes meteorology as a part of physics rather than of geography. Corresponding with this classification we understand that the lectures at Iowa City cover the applications of thermodynamics, hydrodynamics, and physics in general to the problems of the atmosphere, thus laying a solid foundation for the future progress of this science.

Prof. R. D. Calkins, Superintendent of the Department of Geology in the Central State Normal School, Mount Pleasant, Mich., states that—

Our students are all preparing to teach in the schools of Michigan. Various phases of the subject of geography are presented to all my classes. In all courses I put a special emphasis upon the weather and

weather changes, which we follow from day to day by observation and the use of the daily weather map. In my course in meteorology we use Davis as a text-book, which is supplemented by Hann and other references, together with lectures and such explanations as are needed. Now that we have the apparatus, we expect to keep up a systematic record of weather changes. From the data thus supplied blank maps are filled out and completed. Especial emphasis is laid upon the climate of different regions, a subject which is treated of in the course in geography, following the course in meteorology. The MONTHLY WEATHER REVIEW is used daily for reference.

As many libraries, high schools, colleges, and universities, as well as individuals engaged in teaching meteorology, desire to obtain Bartholomew's Atlas of Meteorology, which is in itself a library of information, we take pleasure in communicating the information contained in a letter just received from the American agents:

The Atlas is published at $17.50 net. If any copies are desired for educational institutions or for free public libraries, we can allow a discount of 25 per cent from this price, that being the duty paid to the Government. When the book is to be used in an institution of this kind, all that is necessary is to make an affidavit that it is to be used for educational purposes.

As the atlas weighs a little over 9 pounds, the purchaser can easily estimate the cost of carriage from Philadelphia. In general it can be sent by express cheaper than by mail.

OSCILLATIONS OF TEMPERATURE AT ANY ALTITUDE.

A correspondent recently asked what is known as to the variation of temperature at considerable altitudes above the earth's surface. D. Arthur Berson, the well-known aeronaut, suggested in 1894 that the variation in temperature at any altitude is connected with the variation at the earth's surface by a simple exponential formula, where e is the basis of natural logarithms and h is the altitude in meters;

$$\Delta t_h = \Delta t_0 \, e^{\frac{-h}{1000}}.$$

According to this, if the variation whether diurnal or accidental, is 1° at the earth's surface its amount at other altitudes will be as in the accompanying table:

Altitude.	Variation.	Altitude.	Variation.
Meters.	°	*Meters.*	°
0	1.000	1500	0.223
500	0.607	1600	0.202
600	0.549	1700	0.183
700	0.497	1800	0.165
800	0.449	1900	0.150
900	0.407	2000	0.135
1000	0.368	2250	0.105
1100	0.333	2500	0.082
1200	0.301	3000	0.050
1300	0.272	4000	0.018
1400	0.247	5000	0.007

In his report on the results of recent aeronautic work,[1] Dr. Berson remarks that the formula seems still to hold good but will of course need some slight revision when we have collected a large number of observations at great altitudes.

A WATERSPOUT.

Dr. H. A. Alford of Dominica, W. I., under date of August 25, on the steamship *Fontabelle*, communicates the following:

On the 20th instant, at 7:30 a. m., a very large waterspout, from 600 to 700 feet in diameter at the base, was seen ahead of this ship in latitude 38° 26′ north and longitude 72° 55′ west as kindly determined for me by Captain Mann, and I forward the particulars to you.

The captain has kindly allowed me to take the following extract from his log, which may be useful:

"August 20, strong south-southeast wind to end of day; steamed south one-half east. August 21, strong south-southwest wind and heavy head sea for whole twenty-four hours; shipping heavy water on deck; steering south; midnight, wind moderated and sea went down."

The following were the positions of the ship at noon on August 20 and 21: August 20, latitude 37° 44′ north; longitude 72° 40′ west. August 21, latitude 34° 26′ north; longitude 70° 56′ west.

I shall be obliged if you will inform me whether the stormy weather we experienced was that of the northern segment of a West Indian hurricane.

The weather map of 8 a. m., August 20, shows a trough of low pressure extending along the entire Atlantic coast, with the lowest barometer in the Maritime Provinces, and a subordinate low area central about New York City. The waterspout observed by Dr. Alford was therefore nearly due southeast of this latter storm center, and consequently in the quadrant where both tornadoes and waterspouts are most frequently observed. It was to this slowly eastward moving area of low pressure, and not to a West Indian hurricane, that the winds and sea experienced by the *Fontabelle* may be ascribed.—ED.

ILLNESS OF MR. CURTIS J. LYONS.

Mr. R. C. Lydecker, under date of July 31, announces that, on account of the serious illness of Mr. Curtis J. Lyons, Territorial Meteorologist for Hawaii, he has been appointed by the Surveyor General as Acting Territorial Meteorologist. Having been a member of Mr. Lyons's family for some years, deeply interested in meteorology, and frequently assisting him in his work, the duties of the office are not new to Mr. Lydecker, who will undoubtedly carry on the work according to the same principles that have guided Mr. Lyons.

LIGHTNING PHENOMENON.

The following from the Cleveland Leader is kindly communicated by Father Odenbach, of Ignatius College, in that city:

Geneva, Ohio, November 19.—A phenomenon was seen in Unionville between 5 and 6 o'clock yesterday afternoon, during the snowstorm. There was a flash of lightning, seeming to emanate from the snow itself, and illuminating surrounding buildings and objects quite brightly. It consisted of two almost simultaneous flashes, one stronger than the other, and of a purple and milky-white color. They were followed by a faint roll of thunder like the approach of a distant storm. Such a freak of nature was known to occur during a snowstorm twenty years or more ago.

THE BAROMETRIC DISTURBANCE IN THE DANISH WEST INDIES, NOVEMBER 22-29, 1903.

We are indebted to Mr. John T. Quinn, F. R. G. S. and Royal Gold Medalist, Inspector of Schools in the Danish West Indies, for an early copy of the St. Croix Avis, published at Christiansted, December 5, 1903, from which we print the following article written by him:

The following account of this great movement, which occupied just one week, namely, from Sunday the 22d to Sunday the 29th of November, is mainly based on notes taken in St. Thomas.

The first hint of the approach of the disturbance was given by the high clouds (cirrus, etc.) on the morning of Sunday the 22d. High clouds (cirro-stratus) had been noted on the 19th and 20th as coming from west-northwest, the wind and lower clouds at the same time moving from northeast. On the 21st, at 7:30 a. m., many narrow bands of cirrus were seen, radiating from the south and curving toward the east. Much cirro-stratus also appeared, and both kinds of clouds were moving from the west; but on Sunday morning there was a remarkable display of high clouds, in regard to which the following note was made at the time: "9:15 a. m. A very beautiful band of cirrus and cirro-stratus, stretching about east and west and nearly overhead, the shaft having many faint feathery radiations all looking east; the shaft pointing west and the band a little spreading, plume-like, toward the east. Could not separate the motion of the cirrus and cirro-stratus, the whole appearing to move together from west by south. The sky showed many cirrus shafts having same direction, and some independent patches of cirro-stratus. In one large and very fine patch, with waved silky fibers springing from it in several directions, there was a quantity of cirro-cumulus, but all (cirrus, cirro-stratus, and cirro-cumulus) seemed to be moving together in the same plane."

Cirrus clouds are known among sailors as "mare's tails," and it is well known that an abundance of such clouds is believed by them to in-

[1] Wissenschaftliche Luftfahrten, Vol. III, p. 120, 1900.

dicate wind, a view which at least seems to be confirmed in the present instance.

The barometer on Sunday, the 22d, gave scarcely any indication of an approaching disturbance. At 8 a. m. it stood at 30.02 (previous day at 7 a. m. 30.03) and at 4 p. m. showed 29.97, the difference being little more than the usual daily fall between these two hours. At 4 p. m., however, we find noted, "much nimbus from east by south, giving rain over the sea." This was the first hint of a change in the wind direction and in the character of the weather.

On the following morning (Monday, 23d) we noted: "4:30 a. m., barometer 29.90," and at daylight, "squally, nimbus, and cumulus from southeast, sky entirely overcast." Barometer at 8 a. m. 29.97. At 5 p. m. we have: "Barometer 29.87, cumulus and nimbus from south-southeast, sky entirely overcast; squally, with stiff breeze from east-southeast."

The next morning (Tuesday, 24th) at 4:20 the barometer had fallen to 29.82 and at 8 a. m. stood at 29.87. A stiff breeze was then blowing from south-southeast. At 9 a. m. we noted "sky one gray sheet, from which a scant rain is falling (there were some heavy showers before dawn this morning. A little nimbus from about south." During the morning the wind went round through south to south-southwest, blowing hard all the time, but fell off in the afternoon after some heavy thunder. At 5:20 p. m. we noted: "Wind from about south-southwest, barometer 29.77." Already from the morning it had become pretty clear that a center of disturbance existed westward of St. Thomas and was moving toward the northeast.

On the morning of Wednesday the 25th we noted "3:25 a. m., barometer 29.73, calm, with a gentle movement of the air from about west." At 6:30 a. m. we have: "nimbus from west by north at moderate speed. Barometer 29.80." "8 a. m., barometer 29.82, low clouds from west-northwest." These last entries show that the center of the disturbance had passed to the north of St. Thomas during Tuesday night or early on Wednesday morning, moving eastward (say to about east-northeast). At 5 p. m. the barometer stood at 29.82, therefore 0.05 higher than on the corresponding hour on the previous day. Hence the storm was receding. From Thursday to Saturday calm weather and gentle breezes from the west prevailed, the barometer gradually rising; at 8 a. m. on Saturday it stood at 29.90 and at 8 p. m. at 29.97. The wind in the meanwhile was going round through north to northeast, from which point it was blowing on the morning of Sunday the 29th, when the barometer at 8 a. m. stood at 30.00. On Sunday morning we had the regular trade-wind sky, and the last traces of the disturbance (including the swell on our reef at Christiansted) had disappeared.

The return of the trade wind to the area which had so recently been disturbed brought, however, a welcome fall of rain, measuring from 1.00 inch to 2.50 inches in the different parts of the island.

Readings of the barometer at 8 a. m.

Sunday, November 22	30.02
Monday, November 23	29.97
Tuesday, November 24	29.87
Wednesday, November 25 *	29.82
Thursday, November 26	29.86
Friday, November 27	(Not noted.)
Saturday, November 28	29.90
Sunday, November 29	30.00

* Lowest noted 29.73 at 3:25 a. m.

We give the successive morning readings of the barometer for the week in the table above, and it will be noted that the rise has occupied a longer time than the fall.

It is, of course, impossible with the data at hand to trace the course of the disturbance accurately, but we believe it will be found to have come from the Caribbean to the south of Santo Domingo, or thereabouts, and to have advanced from about west-southwest to east-northeast. The rate of movement has been very slow, probably not more than 7 miles an hour[1] during its approach to St. Thomas and less even than that afterwards. The Weather Bureau stations at Santo Domingo and San Juan will doubtless be able to tell on what side of each of these places the disturbance passed. Possibly it was north of both, but more likely it passed south of Santo Domingo and north of San Juan. It may be that we ought not to rely fully on the indication of the cirrus plumes on the morning of the 22d, but if we do, they indicate the then position of the center as south of Santo Domingo, or on that line, and the distance from St. Thomas was probably between 400 and 500 miles. That the direction of the center was about as indicated is further confirmed by the fact that the lower clouds on Monday afternoon were moving from south-southeast, the surface wind being from east-southeast. The falling barometer showed that the movement was drawing nearer to St. Thomas, and the shift of wind during Tuesday night, taken with the fact that the lowest barometer noted was also at that time, shows that the center was then passing on the north side of St. Thomas. It is likely that it was not far away (much less than a hundred miles probably), which may be inferred from the rapid shifting of the wind during Tuesday night, in spite of the obviously slow movement of the center. Note in this connection that the surface wind between Monday afternoon and Tuesday morning went round from east-southeast to south-southeast (say 4 points in about fifteen hours), whereas, between Tuesday morning and Wednesday morning it went round from south-southeast to about west (say 10 points in about twenty-four hours).

There could have been no hurricane around the cyclone's center, or we would have heard of it from the west, moreover, the steamer *Caribbee* passed in front of it on Tuesday, and on arriving at St. Thomas on Wednesday morning reported only head winds.

It is worth noting that a very similar movement occurred two years ago in the early days of November, 1901. Then also the depression moved up against the trade wind, was attended by considerable calms while the air was moving from the west, and was accompanied by much thunder and lightning. In all these respects, as well as in having no hurricane center, that movement closely resembled the recent one. It differed from it, however, in giving a much larger quantity of rain.

[1] The rate of the forward motion given in the above article is got in this way: If we assume that on Sunday morning the 22d (say at 6 a. m.) when the cirrus clouds were so abundant from west by south, the center was 450 miles away, then the time to 3 a. m. on Wednesday the 25th (about the time the center was passing St. Thomas on the north) is 69 hours, which divided into the 450 miles gives a little over $6\frac{1}{2}$ miles an hour; if we take the distance as 500 miles we get about 7 miles an hour. It is probable that the latter distance assumed is not too great, for we now know that on Tuesday night the disturbance was well marked at Dominica, say over 300 miles from the position of the center at that time. How much farther to the southeast it made itself felt in a less degree we have no means at present of knowing; but it would not surprise us to hear that the barometer at Barbados (150 miles farther on) also showed its influence.

We are indebted to Captain Dix of the R. M. S. *Solent* for the following interesting account, dated November 26, of the cyclone which passed south of Antigua on the 24th instant.—*St. Thomæ Tidende.*

I first experienced the effects of it on Tuesday night at Roseau when a heavy southerly sea came in, and it was with much difficulty that I managed to land my cargo, etc. I left Roseau at 9 p. m., and on approaching Guadeloupe the weather became very stormy and the barometer fell to 29.78, and at Basseterre the sea was running so high that I found it absolutely impossible, and in fact dangerous, to attempt landing anything; however, I sent my mail boat in with the mails, but the officer returned reporting that the seas were breaking clean over the wharf, and he could not land them, so I proceeded, overcarrying several passengers and the mails. On the way to Montserrat we had all the shifts of the wind from east through south to south-southwest. I concluded that the storm was south of us and traveling to the westward.

I arrived at Montserrat at 6:45 a. m. 25th instant; weather very stormy, with terrific squalls of wind and rain, sea running very high. I dared not attempt to anchor. I waited off the port and a boat managed to come off, and I threw the mails into it and proceeded for Antigua, experienced terrific squalls with heavy rain all the way, but in the harbor of St. Johns the sea was moderately smooth. At Nevis also I had a little shelter from the southward and landed cargo and mails.

I arrived at St. Kitts at 11 p. m. and found the sea running very high, with heavy showers and continuous thunder and lightning. I received a letter from our agent, Mr. Horsford, saying it would be impossible to land any cargo, two of his lighters had been smashed to bits on Tuesday night, and several boats were swamped during the day; the customs boat was capsized and one man drowned. I managed with much difficulty to land the mails in my own boat. I left St. Kitts at 1:30 a. m. to-day, and the weather and sea gradually moderated as I approached these islands.

From Captain Dix's narrative it will be seen that the *Solent* on her passage from Guadeloupe to Montserrat, early on the morning of Wednesday, the 25th ultimo, passed through a complete, though very small, cyclone. It was what we might call a "subordinate cyclone"—that is to say, a smaller movement within the area of the larger. If the reader will draw a circle and will first mark the ship's position when the wind came from the east—that is to say, at the top of the circle; next mark it when the wind was from south-southwest—that is to say, on the right-hand of the circle something more than halfway down; lastly, will join these two points by a straight line, and mark in that line the ship's position when the wind was from the south—that is to say, on the right of the circle's center, the diagram will show him that the cyclone passed the steamer with its center on the western side and moving about northwest. It must have been moving rather fast, too, for the steamer was herself moving in about that direction, yet was passed by the cyclone. That this cyclone was not the main movement is plain from this consideration alone: that while these changes of wind were going on between Guadeloupe and Montserrat the wind was blowing hard from about south at Basseterre St. Kitts, to the northwest of the ship's position, and had been so blowing all Tuesday night. The *Solent's* experience explains the telegram from Antigua about a cyclone center to the south of that island, which at first looked meaningless in view of the wider facts. Such small whirls within the larger whirl are not altogether unknown. It seems likely that such a "subordinate cyclone" was met by the cable steamer *Henry Holmes* in the channel between St. Croix and St. Thomas on the night of the 21st

of October, during the passage of an extensive depression on the west side of the Danish Islands and moving to the northwest. The wind from west-northwest that blew at Frederiksted from 10 to 1 that night and did some damage to the small craft there, was probably a part of that minor movement.

The details given in Captain Dix's notes are very interesting and they show that the stormy weather struck the several islands from St. Kitts to Dominica *about the same time*. If we run a line out from the assumed position of the cyclone's center on Tuesday night at right angles to its track and going south-southeast, we shall find that it passed west of the islands, which will lie, roughly speaking, parallel to it. It seems that the whole southeast quadrant of the cyclone was stormy, but was most so in the neighborhood of that line, on the passing of which all of the islands affected were, in fact, at about their nearest to the center. After that had passed and the southwest quadrant was entered, the wind, though maintaining its cyclonic movement, fell to mild westerly breezes. Why it did so is an interesting speculation, but here we only note the fact. Later on information from the different islands may throw further light on the whole subject, but we think that, in the main, the theory given above in our article will be sustained.

POPULAR ARTICLES REQUESTED.

It is doubtless known to many of our readers that the beautiful magazine, St. Nicholas for Young Folks, has for several years devoted a few pages to a department of nature and science, in which occasionally we find something bearing on the weather or the atmosphere. The editor has recently appealed to us for further contributions "on some weather phenomenon of instruction and entertainment to young folks." A similar request has also been received from the editor of the Youths' Companion. We believe we can not do better for the general cause of meteorology than to urge that those who are gifted in writing such sprightly articles as are acceptable to these magazines send their efforts to the St. Nicholas Magazine, Century Company, Union Square, New York City, or to The Youths' Companion, Boston, Mass., so as to make sure that meteorology and its interesting atmospheric phenomena are brought home to the attention of their readers.

BLACK RAIN IN CLERMONT COUNTY, OHIO, AUGUST 19, 1903.

Mr. J. Warren Smith, Section Director, Columbus, Ohio, has forwarded some samples of black rain, collected by Dr. Julius D. Abbott, of Bethel, Ohio, which fell on August 19, 1903, and was the third black rain that had occurred this year. Dr. Abbott says that the creeks and even the furrows in the fields were full of this black water, but the sample that he sends the Weather Bureau was taken out of a perfectly clean porcelain kettle. He states that the black coloring substance does not settle but gives the water a permanent inky appearance. It leaves a black scum on the creek banks and on the grass. A similar description of the rain was received from Daniel Bohl, at Laurel, Clermont County, Ohio.

Samples of the dust from black rains have often been examined microscopically and chemically. An elaborate report of this kind will be found in the MONTHLY WEATHER REVIEW for January, 1895. It seemed likely that a physical examination of the dust and a determination of the size of the particles would be especially interesting in the present case, as Dr. Abbott's sample evidently represented the finest dust of which the great beds of loess are formed. The sample was, therefore, sent to Prof. Milton Whitney, Chief of the Bureau of Soils, who reports as follows:

The material in suspension was found to be completely floculated when the sample was received and would soon settle to the bottom of the vial, even after being violently agitated. The addition of a small amount of ammonia to a part of the sample served to break the floculation, and a microscopic examination of this material showed that it was, for the most part, exceedingly fine, many of the particles being less than one-thousandth of a millimeter in diameter. There were, however, a few transparent crystalline particles which were probably quartz. The vial when first opened emitted a strong odor of hydrogen sulphide. This fact, together with the microscopic examination, leads me to believe that the material is probably extremely fine soil with a considerable portion of organic matter, as Mr. Smith has suggested.

The explanation offered by Mr. Smith is as follows:

These two places are in southern Clermont County, east of a long bend in the Ohio River. I shall be glad to know whether my theory that this "black rain" is the dust blown up in the outrushing squall in advance of the thunderstorm is considered a satisfactory one. The Ohio River must be low at this point and the long drought must have dried the black mud deposit on the river banks into dust so that it would be easily blown high into the air, to be deposited 15 or 20 miles to the east."

We see no reason to doubt the general correctness of Mr. Smith's explanation.

VERTICAL COMPONENTS OF ATMOSPHERIC MOTIONS.

The following passage occurs in a sentence lately examined by the Editor:

The cold, dry air, going off in all directions during a cold wave is not alone due to the temperature of the subarctic regions translated eastward and southward by the general circulation, but equally to the vertical action that is going on within the great anticyclone; a process whereby the cold of the upper air levels is brought down, proving a potent factor in augmenting the cold conditions of the lower strata.

The preceding sentence seems to imply that the cold air of the higher levels, when brought down to the earth's surface, retains its low temperature and augments the cold already prevailing in the lower strata. Does not this simple theory require careful examination? We have actual observations of the temperature of the upper air that give us something like a reliable basis for a computation on this matter. We copy from the MONTHLY WEATHER REVIEW for April, 1901, page 177, the following table, showing the mean temperatures by months, at high altitudes, on days when observations could be obtained by Leon Teisserenc de Bort, at Trappes, near Paris, by means of sounding balloons during 1898, 1899, and 1900:

TABLE 1.—*Mean temperatures.*

Month.	Paris.			Winnipeg.	
	On the ground.	At 5000 meters.	At 10,000 meters.	On the ground.	At 10,000 meters.
	° C.	° C.	° C.	° C.	° C.
January	5.4	—15.3	—47.6	—21	—74
February	1.0	—21.8	—53.4	—19	—73
March	0.9	—20.9	—53.7	—10	—65
April	5.3	—18.4	—49.3	3	—52
May	7.0	—16.8	—51.3	11	—47
June	14.2	— 8.8	—45.3	17	—42
July	15.7	— 8.7	—44.5	20	—40
August	17.8	— 7.2	—41.8	18	—42
September	13.4	— 9.7	—47.9	12	—49
October	10.2	—11.0	—45.1	4.5	—50
November	3.8	—12.8	—45.2	— 6.5	—55
December	0.9	—18.9	—52.4	—16	—69

It will be seen from this table for the latitude of Paris (which is about 48° 15′ north, and corresponds with the latitude of Manitoba), that on these special days the air at 10,000 meters altitude has, for instance, in March, an average temperature of —53.7° C., but of 0.9° at sea level. Now, the charts of mean monthly isotherms for North America give —10° C. for sea level at Winnipeg, in Manitoba, at about the same latitude and other temperatures as shown in the 5th column of Table 1. But these latter figures represent the average of the whole month and not of any special days, such as those on which balloon ascensions can be made; doubtless the averages for balloon work at Winnipeg would be higher than these, because the coldest weather is unfavorable for such work. However, the Paris observations give us a basis for estimating the rate of decrease of temperature with altitude, thus, in March, the temperature at 10,000 meters is 52.8° C. below that at the ground. If we apply the similar differences month by month to Winnipeg we get some idea as to what the average temperature may be at 10,000 meters above Manitoba, and the result is given in the last column of Table 1.

Now, the above explanation of the origin of the cold air in a

cold wave says that it is brought down to the earth's surface. Our first objection to this explanation is that in our American cold waves of the winter time, and in our cool waves of summer, we never experience any such low temperatures as, according to Table 1, must be prevailing above Manitoba all the year round. Neither does Paris experience the cold that is observed in the air a few miles above it. Consequently, if the cold upper air is brought down to the lower strata, and we think very likely that it is, then it must be greatly warmed up on the way down.

Our second objection to the explanation is that, according to a well established law, descending air must be compressed because it comes under greater barometric pressure, and must, therefore, be warmed, just as it is cooled by expansion when it comes under lower pressure. This is a matter of every day experience and knowledge. When air is brought down to the ground at sea level from an altitude of 10,000 meters, it must be warmed up by about 100 °C. as the direct effect of the compression. Consequently the air over Manitoba should, when it reaches the earth's surface, have a temperature of 35° C. in March, and similar high temperatures for the other months. But these extremely high temperatures do not occur in Manitoba any more than do the above-mentioned extremely low ones, and it is fair to conclude that if the atmosphere is ascending or descending, then some other law must be in operation, greatly modifying these figures. We can scarcely doubt but that the lower half of the atmosphere has some vertical as well as horizontal component in its circulation; that is to say, it is generally ascending or descending. Why then does it not arrive at the surface with the high temperatures that result from adding 100° C. to those in the 4th or 6th columns of Table 1.

One explanation is to be found in the loss of heat by radiation from the particles of air themselves, as we have attempted to explain more fully in the American Journal of Science, 1892, 3d series, vol. 43, p. 364; atmospheric Radiation and its Importance in Meteorology. (See also Met. Zeit., July, 1892, vol. 9, p. 259.) According to this, the particles of air are cooling by radiation more than they are being warmed up by the absorption of solar heat. During the long nights of autumn and winter they are of course not being warmed at all. During the short daytimes the warmth that they absorb from the sun's rays does not counterbalance the loss by radiation. But in general this absorption added to the heating produced by compression is greater than the cooling due to radiation, and, therefore, the intensely cold air of the upper layer is warmed as it descends. When its descent takes place on a gentle slope and occupies several days, then the temperature at which it reaches sea level will depend principally upon the radiation and absorption that takes place during this long interval of time. The cooling by radiation may be supposed to take place uniformly at the rate of 0.138° C. per hour, or 3.32° C. per day, if we adopt Maurer's coefficient of radiation. The absorption of solar heat partly compensates this, and gives us 2.88° C. per day as the rate of cooling. This rate of cooling would be entirely compensated by the heat produced by compression if the air descends at the rate of 288 meters per day. These figures are only approximations to what goes on in nature, but illustrate a general principle. When the upper air descends to the ground, it not only becomes relatively dry and brings with it clear sky, as was first demonstrated by Espy, but is also accompanied by a process of heating by compression, cooling by radiation, and warming by absorption, the outcome of which may be either a hot descending wind or a cold descending wind, depending wholly on the rate of descent and on the dust and moisture in the air, which control the radiation and absorption.

It is very desirable that we should have both demonstrations and measurements of the rate of ascent and descent of currents of air. In the Editor's Treatise on Meteorological Apparatus and Methods, some anemometric arrangements are mentioned by which the inclination of the winds to the horizon are supposed to be measured, but these are, in general, very unsatisfactory.

Perhaps the most convincing demonstration of the gentle slope of ascending currents is to be found by watching the slowly circling descent of buzzards and birds of prey, tracing for a hundred miles some little streak of foul air that proceeds from the carrion on the ground far away to the high altitudes at which these birds were soaring. The general slope of such a rising current is often as small as 1°.

The observations of the clouds with the nephoscope generally assume that we are observing the strictly horizontal component of motion. But the vertical component is also revealed by a proper discussion of the observations, and a general slope of 5° over the whole cloud layer visible at any station has sometimes been demonstrated by observations with the perspective nephoscope described in the above-mentioned Treatise on Apparatus and Methods. By another independent method, Mr. Louis Besson, of the Observatory of Montsouris, has lately been able to show that ascending and descending inclinations as large as 14° have been demonstrated in the clouds over Paris for the cirrus, alto-cumulus, and fracto-cumulus clouds. An excellent account of Besson's method is given in the Meteorologische Zeitschrift for September, 1903.

Any contribution to the subject of the vertical component of atmospheric motions will be welcome to the meteorologist.

PROPORTION OF RAINFALL AVAILABLE FOR PLANT USE.

A recent letter from Mr. Thede P. Blake, of Lamar, Nebr., asks:

> What proportion of our rainfall, in Chase County, Nebr., is absorbed by the dry sandy subsoil, and thus taken below the reach of plant roots?

In reply to this letter the Chief of the Bureau of Soils, Prof. Milton Whitney, states:

> We have no data regarding the character of the soil and subsoil of Chase County, Nebr., and consequently it is not possible to give any very definite answer to Mr. Blake's inquiry. In general a rainfall not exceeding 1 inch would probably be held in the upper 18 inches of a loam or clay soil sufficiently long to make the greater part of it available to the plant. This statement is made on the assumption that the soil was rather dry before the rain. A rainfall of 1 inch would increase the moisture content of the upper 18 inches of soil 7 per cent, and such a variation is not abnormal in a clay loam. If the rainfall is sufficient to saturate the soil, a considerable portion would pass into the subsoil and beyond the reach of the roots, although a part of this would be recovered through capillary action.

STATIONARY AND WHIRLED PSYCHROMETERS.

In 1886 the Weather Bureau introduced the use of the whirled psychrometer and the thin muslin covering to the wet bulb, in place of the stationary wet bulb and the thick wicking that had been used for covering. It is generally understood that the whirled psychrometer and the stationary wet bulb agree well enough when the wind velocity is 10 miles per hour or more, but may differ considerably for gentler winds and calms. There is also a decided difference between the wet bulb when covered with very thin clean muslin, and when covered with comparatively thick and oftentimes dirty cotton wicking. In fact the theory of the psychrometer assumes merely the existence of a thin film of water, and the use of a thick wicking necessitates the introduction of a new term in the formula.

It is desirable to investigate the corrections necessary in order to reduce the earlier Weather Bureau observations to the modern standard of the whirled or ventilated psychrometer. Especially is this necessary before we can reduce to the

modern standard the records made by self-recording wet bulbs, where no artificial ventilation is practicable, and which consequently show a diurnal periodicity due to the stronger winds that prevail from 9 a. m. to 4 p. m.

METEOR OBSERVED AT SOUTH BEND, IND.

Mr. W. T. Blythe, Section Director, Indianapolis, Ind., forwards the following note by Mr. H. H. Swaim, Voluntary Observer at South Bend, Ind.:

I was waiting at our railroad depot for the train to Indianapolis to start when, at 4:50 a. m., September 15, 1902, a very bright meteor passed across the eastern horizon from south to north at an altitude of not more than 15° above the horizon, leaving a fiery trail, which disappeared as the sun rose. The atmosphere was somewhat hazy at the time and the first appearance of the sun was natural, but as it reached the altitude at which the meteor passed it assumed a peculiar tint, changing from pink to blue, like a blue gas, and later to a clear white, like the electric light. During the earlier stages of this phenomenon a person could easily look at the sun with the naked eye. My observation of the sun's appearance was made from the railroad train.

The color of the sun as seen through hazy and cloudy air varies with the smallness of the particles of haze; it may be red, pink, yellow, green, or blue, passing from one end of the spectrum to the other as the particles change in size, and again passing through a second and a third series of changes as the particles grow larger, until finally they become too large to produce this effect. All these changes are elaborately described in the experimental work of Prof. Carl Barus, published as Bulletin No. 12 of the United States Weather Bureau, Report on the Condensation of Atmospheric Moisture. The whole subject is one of equal importance to molecular physics and meteorology and is still being investigated by Professor Barus.

The presence of a slight haze is so common and has such a decided influence on the color of the sun that we should naturally attribute to it the pink and blue colors observed by Mr. Swaim. We believe the first observation of this kind was made about 1840, by Mr. J. D. Forbes, when he accidentally viewed the sun through a column of steam issuing from a locomotive; and this led him to his beautiful investigation on the influence of moisture in the atmosphere, the sunset colors, and kindred phenomena. The quantity of gas or vapor constituting the trail of a meteor is so exceedingly slight that we could not expect it to affect the color of the sun. Nevertheless, the suggestion by Mr. Swaim is worthy of consideration. In the present case, however, nearly an hour must have elapsed before the sun could have risen to the altitude of the meteor trail so as to be seen through it, and by that time the trail must have become extremely attenuated. South Bend is in a region where the whole atmosphere is permeated with gases and smoke from soft-coal fires, so that the special influence of gases or dust from meteors is not likely to be appreciable.

In general the long trails that are sometimes left floating behind a meteor are supposed to demonstrate the existence of an atmosphere at great altitudes, and as these trails frequently change their shapes within a few minutes these changes are said to indicate something with regard to the winds prevailing at that high altitude. All observations that can be gathered on this subject are desirable as a possible contribution to the meteorology of the highest atmosphere, but all argumentation and deductions must be held in abeyance until more accurate observations have accumulated.

TERRESTRIAL GLOBES.

Several requests have come from stations desiring terrestrial globes, especially such as show some general meteorological phenomena. Observers will regret to learn that it is at present impracticable for the Central Office to purchase and distribute such globes. On the other hand, as nothing contributes to clearness in our geographic and meteorological conceptions more than the handling of the globe, the Editor suggests that teachers and students either correspond with those who make a cheap and practicable form of globe such as the American Book Company, or Ginn & Company of Boston, or still better try to make one themselves. Nothing better impresses a student than handling the figures, or drawing the lines, or shading the areas that occur in meteorology. As a practical part of every course in meteorology it has always been customary to require the student to transform columns of figures into curves or charts. Just as one makes the morning chart from the manuscript reports, so one may profitably transfer to a globe the figures or the diagrams that are usually published on the plane surface of the pages of a text book or atlas. The main trouble is to obtain a spherical surface. Plain globes with a surface adapted to the use of chalk, slate pencil, or ink are sold by several companies. Perhaps the most convenient and inexpensive globe consists of a large india rubber ball. Balls of 3 to 8 inches in diameter have been used with great success. One may write on these with ink, paint them with water colors, and wash them clean at will. The lines for the equator and the circles of latitude can be left on them permanently. A chart of rainfall or temperature or pressure drawn on the usual Mercator projection becomes more instructive when transferred to such a globe, and we hold it as very important that all school children should be familiar with this true presentation of the meteorological features of the earth.

PERIODIC FLOODS IN THE MISSISSIPPI.

Referring to our note on page 423 of the MONTHLY WEATHER REVIEW for September, 1903, a recent letter from Dr. Cyrus Thomas states that his attention was called to the periodicity of rainfall, chiefly by the general belief of the people of the Mississippi Valley in the periodicity of high water in that river. This belief was current among the aborignies. They looked for it every fourteen years. It is mentioned by De Soto's Chroniclers (See Garcilaso de la Vega, Lib. 5, pt. 2, Chap. VII, p. 222, 1722; and Shipp, Hist. Hern. De Soto, 450, 1881.)

ISLAND STATIONS IN THE SOUTH ATLANTIC OCEAN.

Lieut H. Ballvé, of the Argentine Navy, announces that the Government of the Argentine Republic has determined to give a permanent character to the first class Meteorological and Magnetic Observatory on the island of Año Nuevo, see fig. 1, situated in the vicinity of the Island des États (Staten Island) in latitude 54° 39′ south, and longitude 64° 07′ 30″ (4^h 16^m 30^s) west of the meridian of Greenwich, and which was established in order that the Republic might cooperate with the International Antarctic Expedition.

The island of Año Nuevo is very small and elevated but little above sea level, and we have, therefore, been able to install the observatory under excellent conditions at a distance of only 6 miles, or 12 kilometers, from the mountains of Staten Island. Consequently the observations recorded there must agree essentially with the climate of this region.

A pamphlet giving a full description of the outfit will soon be published, at present it need only be said that the observatory possesses a complete instrumental outfit, such as is appropriate to a station of the first order.

At the end of this present year the observatory will begin the publication of the results obtained during the International Antarctic Expedition, as also of the observations for the present year. Thereafter the results of the observatory will be published regularly.

An exchange of publication is desired. All correspondence

FIG. 1.—Meteorological and Magnetic Observatory of the Argentine Republic on the island of Año Nuevo.

N

sl
th

o
th
o
o

tr
li
G
m

re
of
ta
pl
in
co
ro
or

an
th
in
is
ta

fe
on
tio
is
na

wa
at
res

sh
fro

the
sou
co
Va
ern
fro

eas
pri
of
mu

eas
the
wes
ern
C

7, 1

should be addressed Observatory of Año Nuevo, Ministry of the Marine, Buenos Ayres.

The observatory of the island of Año Nuevo, as well as the one soon to be established at Bahia Blanca, will form a part of the proposed network of observatories on the Atlantic coast of the Argentine Republic, under the direction of the Ministry of the Marine.

A NEW SUGGESTION FOR THERMOMETERS.

Mr. Charles F. Talman, United States Weather Bureau, contributes the following extracts from two papers recently published in the Atti della Reale Accademia dei Lincei,[1] by Prof. G. Guglielmo, of the University of Cagliari, describing a new method of mixing liquids contained in closed receptacles.

In the study of thermic phenomena it is often desired to render uniform the temperature of a liquid by mixing. It often happens, however, that the liquid is inclosed in a receptacle, and the usual methods of agitating liquids are not applicable. In this case the most obvious expedient is to inclose in the receptacle, with the liquid, a mill or movable system containing iron or small magnets, and to cause the mill to rotate or the movable system to oscillate by means of magnetic or electromagnetic action. * * *

The use of the preceding method requires a construction and a preparation more or less complex; nor is there excluded the possibility of an injury which would render the mechanism inactive, without this fact appearing externally, and, lastly, it is hardly applicable if the dimensions of the receptacle containing the liquid are small.

An active agitation can be produced in all cases with perfect certainty, if, before closing the receptacle, there be fixed on its inner walls laminæ (palette) of convenient number, position, and inclination, and if the receptacle, after being closed, is given a movement of rotation in opposite directions alternately on any axis.

If the receptacle, being, for example, cylindrical, had a smooth wall and were made to rotate about its axis, the liquid would at first remain almost completely motionless, and later, as a result of internal friction, the rotary motion would be communicated from the wall toward the axis; this movement of the liquid would, however, be regular and would not produce any mixing of the various parts.

If on the other hand, the inner wall of the receptacle is provided with laminæ, these, at the beginning of the rotation, impinge upon the motionless liquid, and communicate to certain parts of it various velocities and pressures in various directions, as a result of which, as well as of centrifugal force, there is produced a mixture with those portions which are still motionless, or whose motion is not identical. The effect is almost the same as if the laminæ were in a motionless receptacle and were fixed to an axis issuing externally.

If the rotation continued indefinitely, all parts of the liquid would finally acquire the same angular velocity, viz, that of the receptacle, and would move as a solid without appreciable mixing of the parts: if, however, we stop the rotation of the receptacle abruptly the liquid continues to rotate, certain parts of it pass without hinderance between the laminæ, others, striking the laminæ, change direction, and the desired mixing is thus produced. Then, by producing a rotation in the opposite direction, the phenomena, already described, are reproduced, etc.

As to the form, number, position, and inclination of the laminæ, it seems to me useful that they should be small and numerous, that they should extend or be placed near the axis of rotation, and, perhaps, also that they should be perforated. It seems advisable, also, that they should be inclined at an angle of, say, 45° to the axis and to the direction of motion in order to give to the liquid a movement parallel to the axis as well as a movement of rotation.

* * * * * * *

The above arrangement for agitating a liquid * * * certainly appears useful for thermometers, especially if they have large bulbs and are very sensitive, and particularly if the internal liquid is other than mercury, and hence a poor conductor of heat.

CORRIGENDA.

In Monthly Weather Review for October, 1903, p. 478, first column, twelfth line, for 12° 35′ read 120° 35′.

THE WEATHER OF THE MONTH.

By Mr. W. B. Stockman, District Forecaster, in charge of Division of Meteorological Records.

PRESSURE.

The distribution of mean atmospheric pressure is graphically shown on Chart IV and the average values and departures from normal are shown in Tables I and VI.

An area of high mean monthly barometric pressure overlay the country from the middle and northern Plateau regions southeastward to the Gulf of Mexico and the south Atlantic coast, with several crests, the principal one overlying the Ohio Valley and Tennessee, extreme northern Louisiana, and eastern and southwestern Arkansas, with mean values ranging from 30.15 to 30.18 inches.

Two areas of low mean pressure obtained, one over southeastern California and southwestern Arizona, the other and principal one, both with regard to area embraced and lowness of readings, over the north Pacific coast district, where a minimum mean of 29.85 inches was reported.

The mean pressure was below the normal in New England, eastern part of the Middle Atlantic States, along the coast of the South Atlantic States, and over Florida; also in southwestern Arizona, eastern California, and the middle and northern Pacific districts; elsewhere it was above the normal.

Over western Tennessee, the Ohio Valley, New Mexico, Colorado, Kansas, northern Missouri, the upper Mississippi and Missouri valleys, eastern and central Montana, and central Wyoming the departures ranged from +0.05 to +0.08 inch. Over the middle and north Pacific coast districts the departures ranged from —0.05 to —0.13 inch, the greatest departures being reported from the coasts of Washington and northwestern Oregon.

The mean pressure decreased from that of October in northern and eastern New England, and in the north and middle Pacific districts, and in portions of the middle and northern Plateau regions; elsewhere the pressure increased over that of the preceding month, the greatest changes, +0.10 to +0.12 inch, being reported from northwestern Minnesota, northern South Dakota, North Dakota, and northeastern Montana. Over Oregon and Washington, increasing from east to west, the decreases ranged from —0.05 to —0.18 inch, the greatest change being reported from Tatoosh Island.

TEMPERATURE OF THE AIR.

The distribution of maximum, minimum, and average surface temperatures is graphically shown by the lines on Chart VI.

Eastward of a line drawn from eastern Minnesota to eastern Texas, and also in the western portions of the Dakotas, Montana, eastern and extreme western Washington, and north-

[1] Vol. XI, Fas. 11, and Vol. XII, Fas. 6, dated, respectively, December 7, 1902, and March 15, 1903.

central California the mean temperature was below the normal, and above the normal in the remaining districts. Generally in the Atlantic States, northern portion of the east Gulf States, Ohio Valley and Tennessee, lower Lake region, and central Montana the departures ranged from —2.0° to —4.5° per day, the greatest departures occurring over western West Virginia and eastern Kentucky.

From southwestern Nebraska and the western parts of Kansas and Texas westward and northwestward to the western portions of the middle and southern Plateau regions, and over southern Oregon and extreme northwestern and southern California the average daily departures ranged from +2.0° to +5.9°, the greatest departures being reported from north-central New Mexico, southern Idaho, and southern California.

By geographic districts the mean temperature was normal in the Missouri Valley and northern slope district, above the normal in North Dakota, the middle and southern slopes, and the Plateau and Pacific regions; elsewhere it was below the normal. The departures averaged +2.0° or more per day in the southern and middle Plateau and south Pacific districts, and −2.0° or more per day in the Atlantic and east Gulf States and the Ohio Valley and Tennessee.

The isotherm of 70° of mean temperature crossed Florida at about the same latitude that the isotherm of 75° did in November, 1902, and 60° slightly to the southward of the position occupied by 65°. Eastward of the one hundred and tenth meridian the isotherms of mean temperature for November, 1903, generally lay considerably to the southward of their positions in November, 1902.

The average temperatures for the several geographic districts and the departures from the normal values are shown in the following table:

Average temperatures and departures from normal.

Districts.	Number of stations.	Average temperatures for the current month.	Departures for the current month.	Accumulated departures since January 1.	Average departures since January 1.
		°	°	°	°
New England	8	37.6	− 2.3	+ 3.9	+ 0.4
Middle Atlantic	12	41.9	− 2.8	+ 5.9	+ 0.5
South Atlantic	10	51.4	− 2.6	+ 1.1	+ 0.1
Florida Peninsula*	8	64.9	− 1.7	+ 3.4	+ 0.3
East Gulf	9	53.9	− 2.0	− 9.7	− 0.9
West Gulf	7	56.1	− 0.3	−12.1	− 1.1
Ohio Valley and Tennessee	11	42.1	− 3.1	+ 1.8	+ 0.2
Lower Lake	8	37.2	− 1.9	+ 9.0	+ 0.8
Upper Lake	10	32.7	− 0.8	+12.3	+ 1.1
North Dakota*	8	25.4	+ 1.8	+ 3.1	+ 0.3
Upper Mississippi Valley	11	36.4	− 0.9	+ 5.0	+ 0.5
Missouri Valley	11	36.9	0.0	+ 2.0	+ 0.2
Northern Slope	7	32.7	0.0	+ 0.2	0.0
Middle Slope	6	42.4	+ 1.1	− 4.1	− 0.4
Southern Slope*	6	49.5	+ 0.4	−10.1	− 0.9
Southern Plateau*	13	49.5	+ 2.9	− 9.8	− 0.9
Middle Plateau*	8	39.3	+ 2.2	−19.4	− 1.8
Northern Plateau*	12	37.1	+ 0.6	+ 2.8	+ 0.3
North Pacific	7	46.0	+ 0.6	− 1.2	− 0.1
Middle Pacific	5	54.5	+ 1.0	− 3.7	− 0.3
South Pacific	4	60.1	+ 2.6	− 0.7	− 0.1

* Regular Weather Bureau and selected voluntary stations.

In Canada.—Prof. R. F. Stupart says:

The mean temperature of the first ten days of November was above the average in all parts of Canada, and several days were phenomenally warm. On the 11th, however, hard freezing occurred in the Territories, and wintry conditions continued until the close of the month. It was not until the 18th, however, that a pronounced change occurred in Ontario, and several days later in the Maritime Provinces. The largest positive departures from average, about 3°, occurred in Saskatchewan and parts of Nova Scotia, and the largest negative, also about 3°, in southern Alberta and southwestern Ontario.

Maximum temperatures of 90°, or slightly higher, occurred over a small area, extending from southwestern Oklahoma southwestward to southeastern New Mexico, and in the lower Rio Grande Valley. The isotherm of 80° of maximum temperature is located somewhat to the southward of the position it occupied in November, 1902.

At Eastport, Me., New Haven, Conn., Elkins, W. Va., Fort Worth, Tex., Moorhead, Minn., Bismarck, N. Dak., Boise, Idaho, and Baker City, Oreg., the maximum temperature equaled the highest recorded for November since the establishment of the stations; at Albany, N. Y., Port Huron and Detroit, Mich., Green Bay, Wis., and Spokane, Wash., it was 1° higher; at Roseburg, Oreg., and Seattle, Wash., 2° higher; Havre, Mont., and Escanaba and Alpena, Mich., 3° higher; Marquette, Mich., Tacoma, Wash., and Grand Junction, Colo., 5° higher, and 8° higher at Duluth, Minn.

The isotherms of freezing temperature extended to south-central Florida, in Texas to about latitude 29°, to southwestern Arizona, and closely approached the coast in the Pacific States. The isotherms of minimum temperature, as a rule, lay considerably to the southward of their positions in November, 1902.

At Charlotte, N. C., Vicksburg, Miss., and Pensacola, Fla., the minimum equaled the lowest recorded in November since the establishment of stations; at Key West, Fla., Augusta, Ga., and Hatteras, N. C., it was 1° lower; at Tampa, Fla., and Charleston, S. C., 2° lower; at Elkins, W. Va., and Fort Worth, Tex., 3° lower; 4° lower at Binghamton, N. Y., and 6° lower at Jupiter, Fla.

PRECIPITATION.

The distribution of total monthly precipitation is shown on Chart III.

In northern and western Florida, northeast-central and southern Georgia, central Kansas, eastern Nebraska, extreme western Iowa, southeastern Wyoming, central upper Michigan, western Montana, Idaho, except the extreme southeastern portion, northwestern Utah, northern Nevada, and the middle and north Pacific districts the precipitation was above the normal, and below the normal in the remaining districts.

At Pensacola the monthly amount was 7.7 inches above the normal; and more than 3.0 inches above in the western portions of Washington and Oregon, and northwestern California, with departures of +5.4 inches in southwestern Oregon and northwestern California.

Departures of —2.0 inches, or more, from the normal were reported generally from the New England and eastern Middle Atlantic States, southwestern lower Michigan, Indiana, eastern and southern Illinois, the western portions of Kentucky and Tennessee, southern Missouri, the western portion of the east Gulf States, and the eastern portion of the west Gulf States, with the greatest departures, —4.0 to —4.7 inches for the month over southern Arkansas, western Mississippi, Louisiana, and eastern Texas.

By geographic districts the precipitation was normal in the middle Plateau region; above normal in the Florida Peninsula, and northern Plateau and northern and middle Pacific districts, and below normal in the remaining districts. The greatest departures were + 2.9 inches in the middle and +3.5 inches in the northern Pacific districts; and —3.6 inches in the west Gulf States.

The greatest amounts of precipitation, 6 to nearly 22 inches, occurred along the Pacific coast north of central California, and 6 to 10 inches in western Florida and southwestern Georgia. The maximum amount, 21.7 inches, was reported from the extreme northwestern part of California.

No precipitation during the month, or but an inappreciable amount, was reported from western Texas, New Mexico, except the extreme northeastern portion, southwestern Colorado, eastern and southern Utah generally, southern Nevada, the southern third of California, except the extreme southwestern portion, and Arizona.

Heavy snowfalls were reported from the northern Rocky Mountain districts during the month, but little of it remained

on the ground at the end. Moderately heavy falls were also reported from the region about the extreme eastern end of Lake Ontario.

Snow occurred as far south as a line drawn from southern South Carolina west-northwest to Nevada and from east-central California north-northwest to the mouth of the Columbia River, but at the end of the month the line of southern limit of snowfall had receded considerably to the northward and the western limit considerably to the eastward.

HAIL.

The following are the dates on which hail fell in the respective States:

Alabama, 5, 18. Arkansas, 11. California, 1, 4, 14, 15. Connecticut, 16. Georgia, 2. Illinois, 11, 16. Indiana, 11, 16. Indian Territory, 1. Iowa, 4. Kansas, 10. Kentucky, 11. Louisiana, 5. Maine, 17. Massachusetts, 16. Michigan, 5, 11. Minnesota, 22. Mississippi, 5, 6, 11. Missouri, 11, 16. Nebraska, 3. New Hampshire, 16, 17. New York, 14, 16, 17. North Carolina, 6, 17, 25. Ohio, 5, 14, 16. Oregon, 4, 7, 9, 11, 12, 13, 14, 15, 16, 18, 19. Pennsylvania, 14, 17. South Carolina, 5. Tennessee, 3, 16, 17. Texas, 4. Utah, 8, 11, 12, 15. Virginia, 5. Washington, 6, 7, 9, 14, 15, 18, 19.

SLEET.

The following are the dates on which sleet fell in the respective States:

Alabama, 21, 29. Arkansas, 24, 25. California, 14, 15. Connecticut, 16. Georgia, 21, 25. Idaho, 9, 11. Illinois, 5, 6, 11, 12, 28. Indiana, 10, 11, 14, 16. Iowa, 11, 12, 14, 23, 28. Kansas, 30. Kentucky, 25. Maine, 17, 19, 22, 23, 24. Massachusetts, 5, 6, 16, 23. Michigan, 5, 7, 11, 16, 23. Minnesota, 9, 22. Mississippi, 20. Missouri, 11, 13, 16, 24, 25, 26. Montana, 8, 20, 30. Nevada, 12. New Hampshire, 16. New Jersey, 6. New York, 5, 6, 16, 17, 22, 23, 24. North Carolina, 21, 25, 26. North Dakota, 20, 22, 28. Ohio, 14, 23. Oregon, 14, 15. Pennsylvania, 5, 14. South Carolina, 7, 20, 21, 22, 24, 25, 26. South Dakota, 15, 22, 28, 30. Tennessee, 25. Utah, 8, 11, 12, 13. Vermont, 15, 17, 22, 23. Virginia, 15. Washington, 5, 8, 9, 10, 11, 12, 13, 18, 19, 20, 26. Wisconsin, 5, 11, 12, 15, 16, 23. Wyoming, 11, 13, 14, 15, 16, 23.

Average precipitation and departure from the normal.

Districts.	Number of stations.	Average.		Departure.	
		Current month.	Percentage of normal.	Current month.	Accumulated since Jan. 1.
		Inches.		*Inches.*	*Inches.*
New England	8	2.19	56	−1.7	−3.7
Middle Atlantic	12	1.51	49	−1.6	+0.9
South Atlantic	10	2.06	72	−0.8	−2.5
Florida Peninsula *	8	2.71	123	+0.5	+3.5
East Gulf	9	2.32	61	−1.5	−5.2
West Gulf	7	0.31	8	−3.6	−3.6
Ohio Valley and Tennessee	11	2.62	72	−1.0	−6.4
Lower Lake	8	1.60	50	−1.6	+0.4
Upper Lake	10	1.71	68	−0.8	0.0
North Dakota *	8	0.29	42	−0.4	−1.8
Upper Mississippi Valley	11	0.75	35	−1.4	+0.2
Missouri Valley	11	0.87	74	−0.3	+3.8
Northern Slope	7	0.42	82	−0.1	+0.5
Middle Slope	6	0.58	59	−0.4	+0.6
Southern Slope *	6	0.12	8	−1.4	−3.6
Southern Plateau *	13	T.	0	−0.6	−0.1
Middle Plateau *	8	0.87	100	0.0	−0.6
Northern Plateau *	12	2.58	154	+0.9	−2.5
North Pacific	7	10.37	151	+3.5	−4.7
Middle Pacific	5	6.18	188	+2.9	−2.5
South Pacific	4	0.29	22	−1.0	−1.2

* Regular Weather Bureau and selected voluntary stations.

In Canada.—Professor Stupart says:

The precipitation was excessive, and chiefly in the form of rain both in British Columbia and the Maritime Provinces, the largest quantity reported being 12.4 inches at New Westminster, B. C., and 7.6 inches at Halifax, N. S. In all the intervening provinces and territories the rainfall was scant and the snowfall not large.

At the close of the month nearly all portions of Ontario, Quebec, and New Brunswick were snow covered, but in only a few districts on the higher lands was the depth sufficient to make good sleighing. Manitoba and the northern portions of the Territories were also covered, as were also parts of Prince Edward Island.

In the Northwest Territories and Manitoba the ice on ponds and small lakes was from 6 to 11 inches in thickness, and in Ontario and Quebec from 3 to 6 inches, and navigation of canals and harbors was hampered.

HUMIDITY.

The relative humidity was normal in the Ohio Valley and Tennessee, the Upper Mississippi and Missouri valleys, and the southern slope and north Pacific districts; below normal in the Atlantic and Gulf States, Lake region, North Dakota, and the southern Plateau region; and above normal in the remaining districts. The deficiency was quite marked in the west Gulf States, and the excess in the northern and middle slope, the middle Plateau, and middle Pacific districts.

The averages by districts appear in the subjoined table:

Average relative humidity and departures from the normal.

Districts.	Average.	Departure from the normal.	Districts.	Average.	Departure from the normal.
	%			%	
New England	73	− 5	Missouri Valley	71	0
Middle Atlantic	71	− 4	Northern Slope	74	+ 7
South Atlantic	76	− 2	Middle Slope	69	+ 7
Florida Peninsula	81	+ 1	Southern Slope	62	0
East Gulf	74	− 2	Southern Plateau	38	− 5
West Gulf	67	− 7	Middle Plateau	60	+ 8
Ohio Valley and Tennessee	73	0	Northern Plateau	74	+ 4
Lower Lake	74	− 3	North Pacific	85	0
Upper Lake	76	− 4	Middle Pacific	82	+ 7
North Dakota	75	− 4	South Pacific	71	+ 2
Upper Mississippi Valley	74	0			

SUNSHINE AND CLOUDINESS.

The distribution of sunshine is graphically shown on Chart VII, and the numerical values of average daylight cloudiness, both for individual stations and by geographic districts, appear in Table I.

The cloudiness was normal in the southern Plateau region; below in the New England, Middle Atlantic, and Gulf States, Ohio Valley and Tennessee, North Dakota, upper Mississippi Valley, and southern slope region; and above normal in the remaining districts. Except in the northern Plateau and Pacific districts, where they ranged from +1.3 to +2.8, the departures were not marked.

The averages for the various districts, with departures from the normal, are shown in the following table:

Average cloudiness and departures from the normal.

Districts.	Average.	Departure from the normal.	Districts.	Average.	Departure from the normal.
New England	5.2	− 0.4	Missouri Valley	5.6	+ 0.7
Middle Atlantic	5.0	− 0.2	Northern Slope	5.1	+ 0.5
South Atlantic	4.9	+ 0.4	Middle Slope	4.3	+ 0.7
Florida Peninsula	3.8	− 0.8	Southern Slope	2.7	− 0.5
East Gulf	4.4	− 0.1	Southern Plateau	2.3	0.0
West Gulf	4.3	− 0.3	Middle Plateau	4.3	+ 0.7
Ohio Valley and Tennessee	5.6	− 0.1	Northern Plateau	7.3	+ 1.3
Lower Lake	6.7	− 0.5	North Pacific	8.7	+ 1.9
Upper Lake	6.7	− 0.3	Middle Pacific	6.6	+ 2.8
North Dakota	5.1	− 0.2	South Pacific	4.1	+ 1.2
Upper Mississippi Valley	5.1	− 0.2			

WIND.

The maximum wind velocity at each Weather Bureau station for a period of five minutes is given in Table I, which also gives the altitude of Weather Bureau anemometers above ground.

Following are the velocities of 50 miles and over per hour registered during the month:

Maximum wind velocities.

Stations.	Date.	Velocity.	Direction.	Stations.	Date.	Velocity.	Direction.
Buffalo, N. Y.	11	62	w.	North Head, Wash.	14	70	sw.
Do.	12	60	w.	Do.	20	60	s.
Carson City, Nev.	11	64	w.	Do.	25	71	se.
Do.	12	58	sw.	Do.	26	57	s.
Do.	13	58	sw.	Point Reyes Light, Cal.	7	75	nw.
Do.	14	60	sw.	Do.	8	55	nw.
Do.	15	60	w.	Do.	9	59	nw.
Cheyenne, Wyo.	8	55	nw.	Do.	10	63	nw.
Do.	11	56	w.	Do.	14	61	s.
Chicago, Ill.	11	55	sw.	Do.	19	56	se.
Do.	12	69	s.	Do.	20	60	s.
Columbus, Ohio.	11	56	sw.	Salt Lake City, Utah.	12	57	nw.
Eastport, Me.	7	52	ne.	Southeast Farallone, Cal.	7	55	nw.
Havana, Cuba.	21	52	e.	Do.	10	52	nw.
Knoxville, Tenn.	17	50	sw.	Tatoosh Island, Wash.	1	66	s.
Mount Tamalpais, Cal.	3	55	sw.	Do.	3	64	e.
Do.	7	56	nw.	Do.	8	62	s.
Do.	8	55	n.	Do.	9	60	s.
Do.	9	65	nw.	Do.	11	68	e.
Do.	10	65	nw.	Do.	13	50	e.
Do.	13	50	sw.	Do.	17	74	e.
Do.	14	57	sw.	Do.	18	78	e.
New York, N. Y.	24	59	nw.	Do.	19	63	e.
North Head, Wash.	1	61	se.	Do.	21	54	s.
Do.	3	53	s.	Do.	25	62	s.
Do.	4	54	se.	Do.	27	50	e.
Do.	5	84	se.	Do.	28	52	e.
Do.	8	90	se.	Winnemucca, Nev.	11	60	sw.
Do.	9	84	se.	Do.	12	57	sw.
Do.	11	72	w.	Do.	14	58	sw.

ATMOSPHERIC ELECTRICITY.

Numerical statistics relative to auroras and thunderstorms are given in Table IV, which shows the number of stations from which meteorological reports were received, and the number of such stations reporting thunderstorms (T) and auroras (A) in each State and on each day of the month, respectively.

Thunderstorms.—Reports of 894 thunderstorms were received during the current month as against 481 in 1902 and 1770 during the preceding month.

The dates on which the number of reports of thunderstorms for the whole country was most numerous were: 16th, 206; 11, 150; 17, 113.

Reports were most numerous from: Missouri, 109; Ohio, 104; Tennessee, 64.

Auroras.—The evenings on which bright moonlight must have interfered with observations of faint auroras are assumed to be the four preceding and following the date of full moon, viz: 1st to 9th.

In Canada: Thunderstorms were reported from Port Stanley, 16. New Westminster, 20. Hamilton, Bermuda, 2, 3.

Auroras were reported from St. Johns, N. F., 18. Grand Manan, 9. Quebec, 9, 20. Montreal, 18. Kingston, 18. White River, 1. Parry Sound, 18. Port Arthur, 1. Minnedosa, 18, 21, 23, 30. Medicine Hat, 18. Swift Current, 18, 21, 30. Edmonton, 1, 8, 21, 22, 23. Prince Albert, 15, 17, 18. Battleford, 17, 18.

DESCRIPTION OF TABLES AND CHARTS.

By Mr. W. B. STOCKMAN, Forecast Official, in charge of Division of Meteorological Records.

Table I gives, for about 137 Weather Bureau stations making two observations daily and for about 31 others making only one observation, the data ordinarily needed for climatological studies, viz, the monthly mean pressure, the monthly means and extremes of temperature, the average conditions as to moisture, cloudiness, movement of the wind, and the departures from normals in the case of pressure, temperature, and precipitation, the total depth of snowfall, and the mean wet-bulb temperatures. The altitudes of the instruments above ground are also given.

Table II gives, for about 2,800 stations occupied by voluntary and other cooperating observers, the highest maximum and the lowest minimum temperatures, the mean temperature deduced from the average of all the daily maxima and minima, or other readings, as indicated by the numeral following the name of the station, the total monthly precipitation, and the total depth in inches of any snow that may have fallen. When the spaces in the snow column are left blank it indicates that no snow has fallen, but when it is possible that there may have been snow of which no record has been made, that fact is indicated by leaders, thus (....).

Table III gives, for all stations that make observations at 8 a. m. and 8 p. m., the four component directions and the resultant directions based on these two observations only and without considering the velocity of the wind. The total movement for the whole month, as read from the dial of the Robinson anemometer, is given for each station in Table I. By adding the four components for the stations comprised in any geographical division the average resultant direction for that division can be obtained.

Table IV gives the total number of stations in each State from which meteorological reports of any kind have been received, and the number of such stations reporting thunderstorms (T) and auroras (A) on each day of the current month.

Table V gives a record of rains whose intensity at some period of the storm's continuance equaled or exceeded the following rates:

Duration, minutes	5	10	15	20	25	30	35	40	45	50	60	80	100	120
Rates per hour (ins.)	3.00	1.80	1.40	1.20	1.08	1.00	0.94	0.90	0.86	0.84	0.75	0.60	0.54	0.50

In the northern part of the United States, especially in the colder months of the year, rains of the intensities shown in the above table seldom occur. In all cases where no storm of sufficient intensity to entitle it to a place in the full table has occurred, the greatest rainfall of any single storm has been given, also the greatest hourly fall during that storm.

Table VI gives, for about 30 stations furnished by the Canadian Meteorological Service, Prof. R. F. Stupart, director, the means of pressure and temperature, total precipitation and depth of snowfall, and the respective departures from normal values, except in the case of snowfall.

Table VII gives the heights of rivers referred to zeros of gages; it is prepared by the Forecast Division.

NOTES EXPLANATORY OF THE CHARTS.

Chart I, tracks of centers of high areas, and Chart II, tracks of centers of low areas, are prepared by the Forecast Division. The roman numerals show number and chronological order of highs (Chart I) and lows (Chart II). The figures within the circles show the days of the month; the letters *a* and *p* indicate, respectively, the observations at 8 a. m. and 8 p. m., seventy-fifth meridian time. Within each circle is also given (Chart I) the highest barometric reading and (Chart II) the lowest barometric reading at or near the center at that time, and in both cases as reduced to sea level and standard gravity.

Chart III.—Total precipitation. The scale of shades showing the depth of rainfall is given on the chart itself. For isolated stations the rainfall is given in inches and tenths, when appreciable; otherwise, a "trace" is indicated by a capital T, and no rain at all by 0.0.

Chart IV.—Sea-level pressure and resultant surface winds. The pressures have been reduced to sea level and standard gravity by the method fully described by Prof. Frank H. Bigelow on pages 13–16 of the REVIEW for January, 1902. The pressures have also been further reduced to the mean of the twenty-four hours by the application of a suitable correction, to the mean of the 8 a. m. and 8 p. m. readings, at stations taking two observations daily, and to the 8 a. m. or 8 p. m.

observation, respectively, at stations taking but a single observation. The diurnal corrections so applied will be found in Table 27, Volume II, Annual Report of the Chief of Weather Bureau, 1900–1901, pp. 140–164.

The isotherms on the sea-level plane have been constructed by means of the data summarized in chapter 8 of Professor Bigelow's Report on the Barometry of the United States and Canada, which can be found in the Annual Report of the Chief of the Weather Bureau for 1900–1901, Volume II. The correction $t_0 - t$, or temperature on the sea-level plane minus the station temperature, by Table 48 of the Barometry Report, is added to the observed surface temperature to obtain the adopted sea-level temperature.

The wind directions are the computed resultants of observations at 8 a. m. and 8 p. m. daily. The resultant duration is shown by figures attached to each arrow.

Chart V.—Hydrographs for seven principal rivers of the United States, prepared by the Forecast Division.

Chart VI.—Surface temperatures; maximum, minimum, and mean of these. Lines of equal monthly mean temperature in red; lines of equal maximum temperature in black; and lines of equal minimum temperature (dotted) also in black.

Chart VII.—Percentage of sunshine. The average cloudiness at each Weather Bureau station is determined by numerous personal observations during the day. The difference between the observed cloudiness and 100, it is assumed, represents the percentage of sunshine, and the values thus obtained have been used in preparing Chart VII.

Chart VIII. Isobars and isotherms at 10,000 feet. The mean monthly station pressure for each station has been reduced to the 10,000-foot plane by entering Table 53, "Reduction of pressure to the sea level, the 3500 and 10,000-foot planes" pages 789–988, Barometry Report, with the temperature argument t corresponding to θ_2 and correcting the station pressure by the reduction $B_2 - B$ after applying the plateau correction, $C.\ \Delta\ \theta.\ H$, and the corrections for e and $\Delta\ A$, the argument t being the mean monthly air temperature. This reduction is fully described in Professor Bigelow's Report on the Barometry of the United States and Canada, pages 772 to 786 of the Annual Report of the Chief of Weather Bureau for 1900–1901, Volume II. The reduction for obtaining B_2 may also be found by using gradients from the station pressure to the height of 10,000 feet as set forth on pages 18 and 19, of the MONTHLY WEATHER REVIEW for January 1902.

73——6

The isotherms on the 10,000-foot plane have been computed by using the gradients for temperature for each month and station as shown by the Summary Table of Normals, Table 48, Chapter VIII, of Professor Bigelow's Report on the Barometry of the United States and Canada.

Chart IX.—Isobars and isotherms at 3500 feet. The pressure and temperature data entered on this chart are found by the method described for the same data on the 10,000 foot plane.

Chart X.—The total snowfall. This is based on the reports from regular and voluntary observers, and shows the depth of the snowfall during the month in inches. In general, the depth is shown by lines inclosing areas of equal snowfall, but in special cases figures are also given.

Chart XI.—Depth of snow on ground at the end of the month.

When there is no snow the last two charts may be replaced by others.

TABLE 1.—*Climatological data for Weather Bureau stations, November, 1903.*

Stations.	Elevation of instruments.			Pressure, in inches.			Temperature of the air, in degrees Fahrenheit.									Mean wet thermometer.	Mean temperature of the dew-point.	Mean relative humidity, per cent.	Precipitation, in inches.			Wind.					Clear days.	Partly cloudy days.	Cloudy days.	Average cloudiness, tenths.	Total snowfall.
	Barometer above sea level, feet.	Thermometers above ground.	Anemometer above ground.	Actual, reduced to mean of 24 hours.	Sea level, reduced to mean of 24 hrs.	Departure from normal.	Mean max. + mean min. ÷ 2.	Departure from normal.	Maximum.	Date.	Mean maximum.	Minimum.	Date.	Mean minimum.	Greatest daily range.				Total.	Departure from normal.	Days with .01, or more.	Total movement, miles.	Prevailing direction.	Maximum velocity: Miles per hour.	Direction.	Date.					
New England.							37.6	−2.3										73	2.19	−1.7										5.2	
Eastport	76	69	82	29.85	29.93	−.08	35.6	−1.1	64	4	41	13	27	30	22	33	30	80	3.59	−0.6	12	8,586	w.	52	ne.	7	6	7	17	7.1	13.2
Portland, Me.	103	81	117	29.86	29.99	−.05	35.8	−2.2	67	4	43	10	27	29	28	32	26	70	1.44	−2.6	9	5,994	nw.	34	nw.	7	12	7	11	5.3	2.8
Concord	298	70	79	29.67	30.01	−.05	34.6	−2.7	71	4	44	5	27	25	34	...	...	...	1.40	−2.0	8	3,647	nw.	24	nw.	7	14	10	6	4.5	0.3
Northfield	876	16	60	29.05	30.03	−.02	29.7	−3.2	68	4	39	−2	26	20	35	26	22	77	1.04	−2.1	8	5,010	s.	34	nw.	7	8	10	12	6.2	4.1
Boston	125	115	181	29.86	30.01	−.04	40.0	−0.6	74	4	47	15	27	33	26	35	28	65	1.48	−3.1	8	7,108	w.	33	nw.	7	15	3	12	4.7	2.4
Nantucket	12	43	82	29.98	29.99	−.06	42.8	−1.9	64	4	48	23	26	38	18	40	36	79	3.82	+0.3	15	10,554	nw.	43	n.	28	6	9	15	6.4	7.2
Block Island	26	11	60	30.01	30.04	−.02	42.0	−2.9	67	4	48	22	27	36	22	39	34	73	2.77	−1.4	11	13,061	nw.	44	nw.	25	16	5	9	4.3	3.6
Narragansett	...	10	38	...	...	...	39.4	−3.6	71	4	49	12	26	30	26	...	...	...	2.31	−1.8	9	...	nw.	...		...	19	0	11	...	3.0
New Haven	106	117	140	29.92	30.04	−.03	38.6	−2.5	72	4	47	13	27	30	27	33	28	68	1.85	−2.1	6	6,049	n.	36	w.	24	20	3	7	3.2	T.
Mid. Atlantic States.							41.9	−2.8										71	1.51	−1.6										5.0	
Albany	97	102	115	29.95	30.06	−.02	36.5	−2.7	71	4	44	12	27	29	31	32	29	79	1.65	−1.3	9	4,664	nw.	25	w.	24	11	10	9	5.0	T.
Binghamton	875	79	90	29.10	30.06	−.03	34.2	−3.8	67	4	42	7	29	26	34	...	...	...	2.26	−0.1	11	4,163	w.	25	w.	12	9	7	14	6.1	0.7
New York	314	108	350	29.71	30.06	−.03	41.4	−2.0	70	4	48	17	27	35	23	36	30	66	0.90	−2.9	6	9,881	nw.	59	nw.	24	17	5	8	4.0	T.
Harrisburg	374	94	104	29.70	30.11	.00	39.6	−2.8	72	3	47	17	27	32	28	34	28	69	0.88	−1.9	7	4,769	nw.	28	nw.	24	9	10	11	5.4	0.2
Philadelphia	117	168	184	29.97	30.10	.00	42.5	−1.4	72	4	50	18	27	35	27	37	30	65	1.03	−2.2	4	7,298	nw.	29	nw.	18	12	12	6	4.4	T.
Scranton	805	111	119	29.20	30.08	−.01	36.4	...	69	4	45	12	26	28	32	32	26	71	1.86	...	8	4,667	sw.	29	nw.	24	8	7	15	6.2	0.3
Atlantic City	52	39	48	30.03	30.09	−.01	42.1	−2.6	73	3	50	16	27	34	27	38	33	74	1.86	−1.6	9	5,534	nw.	20	n.	6	12	10	8	4.5	0.2
Cape May	17	47	51	30.00	30.11	+.01	44.0	−2.6	70	4	50	20	26	38	23	39	...	...	1.93	−1.4	8	6,102	nw.	27	nw.	12	10	17	3	4.4	T.
Baltimore	123	69	117	29.96	30.10	−.01	43.2	−2.2	75	3	52	18	27	34	28	37	29	60	0.73	−2.3	7	4,619	nw.	29	nw.	24	7	15	8	5.7	1.0
Washington	112	59	76	30.00	30.12	.00	41.6	−2.9	73	3	52	18	27	31	32	36	32	74	0.80	−2.0	6	4,459	nw.	28	nw.	17	13	11	6	4.3	0.6
Cape Henry	18	11	58	30.08	30.10	.00	46.8	−5.1	76	17	53	25	30	41	26	...	...	...	2.61	−1.0	7	10,625	nw.	48	nw.	27	9	9	12	5.7	0.1
Lynchburg	681	83	88	29.36	30.13	.00	43.5	−2.8	76	3	54	17	28	32	37	36	31	69	1.34	−1.6	7	2,937	nw.	22	nw.	18	14	11	5	4.2	1.4
Norfolk	91	102	111	30.02	30.12	+.01	47.1	−3.2	78	4	54	23	28	40	27	42	37	72	2.14	−1.0	5	5,972	n.	31	sw.	16	11	7	12	5.4	0.1
Richmond	144	82	90	29.98	30.14	+.02	44.8	...	75	4	55	20	27	35	31	...	...	...	1.40	...	6	3,404	n.	28	sw.	16	7	13	10	5.3	0.4
Wytheville	2,293	40	47	27.69	30.15	+.02	37.6	...	72	3	49	2	30	26	40	32	29	78	2.06	...	10	3,450	nw.	28	w.	23	11	13	6	4.4	6.0
S. Atlantic States.							51.4	−2.6										76	2.06	−0.8										4.9	
Asheville	2,255	53	75	27.75	30.13	−.01	41.4	−4.1	72	3	52	13	19	31	39	36	33	78	2.32	−0.4	6	5,948	nw.	28	nw.	29	8	15	7	5.3	0.1
Charlotte	773	68	76	29.28	30.14	+.01	47.6	−2.3	76	3	56	18	27	39	28	41	35	66	1.43	−1.6	4	4,397	ne.	27	w.	17	11	7	12	5.5	T.
Hatteras	11	12	47	30.09	30.10	−.01	51.8	−3.8	74	17	57	27	28	47	19	48	46	86	3.52	−1.7	9	11,006	n.	45	n.	27	12	13	5	4.5	1.0
Raleigh	376	71	79	29.72	30.13	.00	47.2	−2.4	79	3	57	18	28	38	32	41	36	71	0.88	−1.3	4	4,147	n.	21	sw.	17	17	8	5	3.7	T.
Wilmington	78	82	90	30.02	30.10	−.02	50.9	−3.7	78	1	60	21	28	42	33	44	40	73	1.03	−1.4	11	5,449	n.	28	n.	6	11	12	7	4.5	
Charleston	48	14	92	30.07	30.12	.00	55.4	−2.2	79	14	63	26	28	48	26	49	45	75	1.20	−1.8	9	8,057	n.	33	n.	27	10	11	9	4.9	
Columbia, S. C.	351	167	175	29.74	30.13	+.01	51.6	−3.2	76	1	60	22	28	43	26	46	42	77	1.36	−1.0	8	6,864	ne.	36	ne.	6	6	15	9	5.9	T.
Augusta	180	89	97	29.93	30.13	.00	51.9	−1.5	78	1	60	22	28	43	31	46	42	75	3.20	+0.2	7	4,113	ne.	24	ne.	6	11	9	10	5.2	
Savannah	65	79	89	30.04	30.11	−.01	56.4	−1.4	81	13	65	25	28	48	28	49	44	73	1.84	−0.4	9	5,775	n.	27	e.	6	11	15	4	4.3	
Jacksonville	43	101	129	30.02	30.07	−.03	59.6	−1.8	81	14	67	26	28	52	26	54	51	82	3.82	+1.3	11	6,866	n.	33	ne.	20	9	13	8	5.4	
Florida Peninsula.							68.8	−2.4										81	2.12	−0.2										3.8	
Jupiter	28	10	48	30.00	30.03	−.02	69.6	−2.2	84	5	76	36	28	63	25	64	61	81	2.50	−0.4	14	8,270	ne.	38	n.	8	12	17	1	4.2	
Key West	22	10	53	30.00	30.02	.00	72.3	−1.9	83	4	77	51	28	68	18	67	65	80	0.76	−1.5	3	7,399	ne.	26	n.	26	13	15	2	3.6	
Sand Key	24	...	...	29.98	30.01	...	72.9	...	82	25	76	52	28	70	13	...	...	...	0.61	...	5	12,564	ne.	46	ne.	20	10	16	4	4.4	
Tampa	34	60	67	30.02	30.06	−.02	64.4	−3.0	86	1	73	32	28	56	25	58	56	83	3.09	+1.3	6	4,353	n.	20	ne.	3	15	13	2	3.2	
East Gulf States.							53.9	−2.0										74	2.52	−1.5										4.4	
Atlanta	1,174	190	216	28.87	30.13	.00	48.0	−3.8	74	2	55	18	27	41	31	43	38	72	3.08	−0.5	11	9,081	nw.	42	nw.	17	7	12	11	5.7	
Macon	370	93	99	29.73	30.13	.00	51.9	...	78	14	60	22	27	44	29	...	...	...	3.05	...	15	4,163	nw.	23	e.	20	11	7	12	5.3	
Pensacola	56	79	96	30.06	30.12	+.01	58.1	−1.1	78	16	66	28	27	50	29	...	...	...	11.46	+7.7	8	7,119	ne.	30	sw.	28	15	9	6	3.6	
Birmingham	700	136	143	29.38	30.15	+.03	50.4	−3.9	78	2	59	18	27	41	35	...	...	...	0.42	−3.4	5	5,839	n.	26	n.	26	14	6	10	4.5	
Mobile	57	88	96	30.06	30.12	+.01	56.8	−1.1	79	2	66	26	19	48	34	51	46	75	0.85	−3.0	4	5,230	n.	30	n.	25	14	15	1	3.6	
Montgomery	223	100	112	29.89	30.12	.00	52.6	−2.6	80	15	62	23	27	43	33	48	44	80	1.61	−1.8	6	4,593	ne.	34	se.	1	11	10	9	5.1	
Meridian	375	84	93	29.73	30.14	+.02	51.6	−1.8	80	16	63	21	27	41	39	...	...	...	0.71	−2.4	6	3,797	ne.	20	sw.	28	13	8	9	4.6	
Vicksburg	247	62	74	29.85	30.12	.00	54.6	−0.8	81	16	64	22	19	45	35	47	41	68	0.25	−4.6	3	4,675	n.	26	nw.	11	14	11	5	3.6	
New Orleans	51	88	121	30.06	30.12	+.02	59.4	−1.3	83	12	68	29	19	50	34	53	49	76	0.18	−4.0	3	6,066	n.	28	nw.	17	15	10	5	4.0	
West Gulf States.							56.1	−0.3										67	0.31	−3.6										4.3	
Shreveport	249	77	84	29.87	30.15	+.04	53.8	−0.8	83	13	65	20	19	43	37	46	38	62	0.04	−4.7	1	4,463	se.	23	nw.	11	15	6	9	4.6	
Fort Smith	457	79	94	29.64	30.13	+.02	48.2	−1.1	78	15	58	18	19	38	35	41	35	65	0.86	−2.8	3	6,361	e.	36	w.	11	13	10	7	4.2	
Little Rock	357	93	100	29.76	30.15	+.03	49.0	−1.8	76	13	58	20	18	40	36	42	35	64	0.66	−4.6	5	5,429	nw.	32	nw.	11	11	11	8	5.2	
Corpus Christi	20	48	53	30.09	30.11	+.04	63.9	+0.9	84	13	71	37	18	57	38	57	53	74	0.56	−2.4	5	6,679	n.	27	n.	17	11	12	7	4.5	
Fort Worth	670	106	114	29.42	30.15	+.05	53.8	...	85	13	65	20	18	43	39	...	...	...	0.00	...	0	7,607	n.	38	s.	10	24	5	1	2.8	
Galveston	54	106	112	30.05	30.11	+.02	61.9	−0.5	79	11	67	35	19	57	22	56	52	75	0.03	−4.4	1	8,220	s.	37	ne.	18	14	11	5	3.6	
Palestine	510	73	79	29.60	30.14	+.03	56.0	−0.2	84	13	66	23	19	46	35	48	42	69	0.01	−4.4	1	5,438	s.	24	nw.	11	14	10	6	4.3	
San Antonio	701	80	91	29.38	30.11	+.03	60.2	+1.2	87	15	71	31	18	49	37	51	44	62	T.	−2.1	0	4,827	se.	30	n.	17	14	8	8	4.2	
Taylor	583	55	63	29.52	30.13	+.05	56.9	...	85	15	69	24	18	45	40	...	...	...	0.34	...	3	5,968	s.	30	n.	17	9	13	8	4.9	
Ohio Val. and Tenn.							42.1	−3.1										73	2.62	−1.0										5.6	
Chattanooga	762	106	112	29.34	30.17	+.03	46.6	−3.3	76	2	56	18	27	38	33	41	36	70	3.56	−0.2	8	4,848	nw.	35	w.	28	12	10	8	4.8	
Knoxville	1,004	35	88	29.07	30.15	+.02	44.4	−2.2	74	3	54	16	27	35	33	38	34	73	4.19	+0.4	5	4,973	ne.	50	sw.	17	10	8	12	5.7	T.
Memphis	397	146	154	29.73	30.17	+.05	48.4	−1.5	78	15	57	20	18	40	28	42	35	64	2.38	−2.3	6	6,025	nw.	39	nw.	11	16	6	8	4.1	
Nashville	546	122	134	29.58	30.18	+.06	45.2	−2.8	73	2	54	18	27	36	32	40	35	72	3.47	−0.4	8	5,177	nw.	32	sw.	11	12	10	8	4.2	T.
Lexington	989	75	102	29.07	30.17	+.05	40.0	−4.5	71	3	48	12	27	32	28	...	...	...	2.84	−0.9	10	7,405	sw.	40	sw.	11	8	9	13	5.7	5.6
Louisville	525	114	136	29.58	30.17	+.05	42.0	−3.3	70	16	50	17	27	34	29	38	34	77	2.71	−1.4	11	5,596	n.	41	sw.	11	10	11	9	5.2	1.2
Evansville	431	72	82	29.66	30.15	+.03	42.6	...	73	2	50	16	18	35	30	...	...	...	1.77	...	7	5,446	nw.	30	s.	11	8	10	12	5.3	1.7
Indianapolis	822	154	164	29.23	30.14	+.04	38.2	−2.7	71	3	46	14	27	30	25	34	30	75	1.67	−2.2	6	7,208	s.	41	sw.	11	14	7	9	4.9	1.3
Cincinnati	628	152	160	29.46	30.16	+.04	40.4	−3.5	75	3	49	14	27	32	30	36	31	72	1.45	−1.8	10	4,800	se.	35	w.	11	9	8	13	6.2	1.4
Columbus	824	173	190	29.24	30.14	+.03	38.4	−2.8	70	2	47	12	27	30	30	33	28	72	2.01	−1.3	9	7,851	sw.	56	sw.	11	7	7	16	6.3	3.2
Pittsburg	842	116	123	29.20	30.12	+.02	39.5	−3.3	69	3	47	17	27	32	32	34	29	69	2.60	+0.1	7	4,123	nw.	26	nw.	11	7	10	13	6.1	1.0
Parkersburg	638	77	84	29.48	30.18	+.06	39.6	−4.4	74	3	48	16	28	31	36	35	31	77	1.94	−1.1	12	4,086	s.	42	nw.	11	5	9	16	7.1	2.1
Elkins	1,940	41	50	28.04	30.14	+.02	35.6	...	72	4	47	5	28	24	47	30	27	80	2.71	...	13	2,610	w.	24	w.	11	6	8	16	6.7	7.4
Lower Lake Region.							37.2	−1.9										74	1.60	−1.6										6.7	
Buffalo	767	178	206	29.21	30.06	+.01	37.6	−0.6	63	11	43	14	26	32	29	33	28	71	1.36	−2.2	10	11,614	w.	62	w.	11	3	7	20	7.9	1.1
Oswego	335	76	91	29.67	30.04	−.01	36.2	−2.3	64	4	42	14	21	30	24	32	28	76	2.46	−0.9	12	8,880	s.	34	ne.	5	7	6	17	6.7	8.6
Rochester	523	81	102	29.48	30.06	+.01	36.3	−1.1	67	4	43	14	26	30	25	31	27	74	1.50	−1.4	11	6,813	sw.	36	sw.	12	6	9	15	6.6	4.4
Syracuse	597	97	113	29.40	30.05	−.01	36.0	...	66	4	42	9	29	30	27	...	...	...	2.01	...	12	9,022	w.	45	w.	24	5	13	12	6.2	7.3
Erie	713	92	102	29.98	30.07	+.01	37.6	−3.4	67	4	43	18	29	32	28	34	29	72	1.87	−2.3	14	7,733	s.	30	sw.	11	6	2	22	7.6	5.4
Cleveland	762	190	201	29.26	30.10	+.03	37.5	−2.2	69	4	44	17	18	31	29	34	30	77	1.91	−1.0	15	11,863	s.	47	sw.	23	5	6	19	7.4	7.8
Sandusky	629	62	70	29.42	30.12	+.04	38.4	−2.0	68	11	45	14	27	32	29	...	...	...	1.47	−1.6	7	6,234	sw.	33	nw.	24	9	9	12	5.6	0.9
Toledo	628	120	127	29.41	30.11	+.04	37.3	−1.9	70	3	45	12	26	30	28	32	27	70	1.01	−1.8	8	6,817	sw.	30	se.	11	7	11	12	5.6	1.6
Detroit	730	153	193	29.27	30.08	+.02	36.4	−1.7	71	3	43	13	26	30	25	33	30	80	1.18	−1.5	11	8,163	sw.	36	sw.	11	5	7	18	6.6	2.3
Upper Lake Region.							32.7	−0.8										76	1.71	−0.8										6.7	
Alpena	609	63	80	29.35	30.03	+.02	33.0	+0.2	70	3	40	10	26	26	31	29	26	81	1.36	−1.4	9	8,374	w.	38	se.	11	3	6	21	8.1	4.3
Escanaba	612	40	48	29.35	30.04	+.01	30.8	−0.4	68	4	38	5	27	24	31	27	24	82	1.76	−0.5	6	6,372	w.	30	n.	4	11	6	13	5.8	6.9
Grand Rapids	707	127	165	29.29	30.08	+.04	35.6	−2.0	71	3	43	10	26	29	32	32	29	80	0.85	−2.6	10	7,918	w.	48	sw.	9	7	5	18	7.1	5.0
Houghton	668	66	74	29.28	29.99	−.03	32.0	...	67	3	37	11	27	27	22	...	...	...	5.17	...	19	5,736	nw.	32	w.	13	4	4	22	8.1	35.5
Marquette	734	79	116	29.20	30.02	.00	32.2	+0.8	74	3	38	10	27	26	31	28	22	71	4.63	+1.9	16	9,490	w.	44	sw.	21	6	6	18	7.1	40.4
Port Huron	638	70	120	29.38	30.00	+.04	34.6	−1.8	70	3	42	11	26	28	28	31	27	78	2.78	−0.1	7	8,806	sw.	38	w.	11	6	5	19	7.5	29.2
Sault Ste. Marie	614	40	61	29.30	29.99	−.02	29.8	−0.5	62	4	36	4	26	24	27	27	23	76	1.69	−0.8	12	6,563	sw.	38	n.	4	1	9	20	7.9	10.4
Chicago	823	241	274	29.20	30.12	+.05	36.4	−2.0	63	4	43	12	26	30	24	32	27	71	0.34	−2.4	6	12,200	w.	69	s.	12	10	11	9	5.2	2.2
Milwaukee	681	124	142	29.35	30.11	+.06	34.8	−0.4	64	2	41	11	26	28	26	30	26	75	1.49	−0.6	5	7,579	w.	41	sw.	12	13	8	9	4.5	2.9
Green Bay	617	49	86	29.40	30.08	+.04	31.2	−0.9	69	3	39	4	27	24	28	27	23	74	1.25	−0.8	7	8,482	sw.	42	sw.	9	9	5	16	6.5	3.7
Duluth	702	95	116	29.29	30.09	+.05	28.4	−1.0	73	3	35	−4	26	22	22	25	20	74	0.95	−0.7	6	8,050	sw.	43	nw.	10	10	12	8	5.4	9.5

TABLE I.—*Climatological data for Weather Bureau stations, November, 1903*—Continued.

Stations.	Elevation of instruments.			Pressure, in inches.			Temperature of the air, in degrees Fahrenheit.												Precipitation, in inches.			Wind.									
	Barometer above sea level, feet.	Thermometers above ground.	Anemometer above ground.	Actual, reduced to mean of 24 hours.	Sea level, reduced to mean of 24 hrs.	Departure from normal.	Mean max. + mean min. ÷ 2.	Departure from normal.	Maximum.	Date.	Mean maximum.	Minimum.	Date.	Mean minimum.	Greatest daily range.	Mean wet thermometer.	Mean temperature of the dew-point.	Mean relative humidity, per cent.	Total.	Departure from normal.	Days with .01, or more.	Total movement, miles.	Prevailing direction.	Maximum velocity. Miles per hour.	Maximum velocity. Direction.	Maximum velocity. Date.	Clear days.	Partly cloudy days.	Cloudy days.	Average cloudiness, tenths.	Total snowfall.
North Dakota.							25.3	− 0.2										75	0.22	− 0.5										5.1	
Moorhead	935	54	60	29.07	30.13	+ .06	24.5	+ 0.3	72	2	34	−11	24	15	38	21	18	83	0.24	− 0.7	3	7,666	nw.	35	se.	6	11	11	8	5.0	2.4
Bismarck	1,674	16	29	28.29	30.14	+ .07	26.5	+ 0.6	73	2	37	− 8	19	16	41	22	15	66	0.23	− 0.4	3	7,484	nw.	35	nw.	17	13	14	3	4.4	2.3
Williston	1,875	14	44	28.04	30.10	+ .04	24.8	− 1.3	69	2	35	−16	19	15	43	20	16	77	0.18	− 0.4	7	6,966	nw.	45	n.	8	9	6	15	6.0	1.8
Upper Miss. Valley.							30.4	− 0.9										74	0.75	− 1.4										5.1	
Minneapolis	......	99	208	......	......	......	29.8	+ 0.1	66	2	37	0	26	22	26	......	......	......	0.31	− 0.4	3	9,026	nw.	38	n.	29		12	10		2.5
St. Paul	837	102	122	29.17	30.11	+ .05	30.6	+ 0.7	69	2	38	0	26	23	28	27	23	77	0.35	− 0.8	5	6,471	nw.	30	nw.	29	11	7	12	5.2	2.9
La Crosse	714	71	87	29.33	30.13	+ .06	32.7	− 0.7	66	1	40	6	26	25	26	......	......	......	0.04	− 1.4	2	6,155	n.	28	n.	29	8	10	12	5.8	0.5
Davenport	606	71	79	29.45	30.11	+ .03	36.2	− 0.6	68	1	44	9	26	28	24	32	27	74	0.70	− 1.4	3	5,796	w.	30	w.	9	10	11	9	5.0	T.
Des Moines	861	84	99	29.20	30.16	+ .08	36.2	− 0.2	69	1	44	10	17	28	25	32	26	70	0.31	− 1.4	2	6,769	nw.	35	w.	9	9	10	11	5.7	0.1
Dubuque	698	100	117	29.36	30.13	+ .06	34.4	− 0.6	70	2	42	7	26	26	26	30	25	73	0.75	− 1.4	4	5,613	nw.	32	nw.	23	11	12	7	4.9	0.4
Keokuk	614	63	78	29.45	30.13	+ .04	37.5	− 1.3	67	3	44	11	26	30	28	33	28	75	0.87	− 1.2	5	5,867	nw.	34	sw.	12	12	11	7	4.3	0.2
Cairo	356	87	93	29.77	30.17	+ .05	44.5	− 1.7	75	15	53	17	18	36	33	39	34	70	2.07	− 2.2	5	6,461	nw.	38	nw.	11	7	14	9	5.5	2.7
Springfield, Ill.	644	82	93	29.44	30.14	+ .04	38.3	− 2.6	69	1	47	13	26	30	32	34	29	75	0.98	− 2.0	7	7,177	nw.	31	s.	12	8	12	10	5.8	0.6
Hannibal	534	75	109	29.55	30.14	+ .05	38.8	− 1.4	70	3	48	7	27	30	37	......	......	......	1.28	− 0.8	5	6,958	n.	37	w.	11	12	11	7	4.4	3.9
St. Louis	567	208	217	29.52	30.14	+ .04	41.8	− 1.8	71	3	50	14	18	33	37	37	32	74	0.61	− 2.5	6	8,354	se.	44	nw.	28	12	11	7	4.6	1.5
Missouri Valley.							36.9	0.0										71	0.87	− 0.3										5.6	
Columbia, Mo.	784	11	84	29.29	30.14	+ .05	39.9	− 3.1	75	15	50	11	18	30	45	......	......	......	0.71	− 1.6	6	6,702	se.	38	nw.	28	9	4	17	6.0	1.4
Kansas City	963	78	95	29.10	30.17	+ .08	41.2	+ 0.5	71	15	48	14	18	34	32	36	30	68	1.61	− 0.6	7	6,374	nw.	36	nw.	28	13	5	12	5.1	0.6
Springfield, Mo.	1,324	98	104	28.70	30.14	+ .04	42.6	− 0.9	73	15	51	13	18	34	38	37	32	72	0.78	− 2.3	8	8,272	se.	36	nw.	28	16	4	10	4.4	T.
Topeka	......	81	89	......	......	......	40.8	− 0.4	73	15	49	12	18	33	35	......	......	......	1.09	0.0	5	6,876	s.	31	s.	10	9	9	12	5.7	2.0
Lincoln	1,189	75	84	28.83	30.13	+ .05	38.5	+ 0.4	64	8	46	8	17	31	31	33	27	69	1.81	+ 1.1	6	8,278	s.	38	nw.	9	9	11	10	5.5	1.3
Omaha	1,105	115	121	28.92	30.14	+ .06	38.2	+ 1.6	65	8	45	8	17	31	24	33	28	71	1.01	0.0	9	7,145	s.	37	nw.	9	7	12	11	6.1	1.8
Valentine	2,598	47	54	27.31	30.10	+ .02	35.4	+ 1.1	78	8	48	− 1	17	23	44	28	23	71	0.04	− 0.4	3	7,501	nw.	36	sw.	10	10	7	13	5.9	0.3
Sioux City	1,135	96	164	28.88	30.13	+ .05	34.7	+ 0.4	68	2	42	5	17	27	26	......	......	......	0.96	+ 0.1	4	10,059	nw.	43	nw.	9	7	9	14	6.3	6.9
Pierre	1,572	43	50	28.44	30.16	+ .08	32.2	+ 0.3	72	3	42	2	17	23	39	26	20	68	0.52	+ 0.1	4	5,579	nw.	32	nw.	28	10	10	10	5.2	5.2
Huron	1,306	56	67	28.70	30.15	+ .07	29.2	− 0.3	71	8	41	− 9	26	18	39	24	20	78	0.37	− 0.2	4	8,620	nw.	36	s.	20	8	7	15	6.2	3.8
Yankton	1,233	42	49	28.77	30.13	+ .05	33.5	+ 0.7	70	2	42	0	17	25	30	......	......	......	0.70	0.0	5	5,985	nw.	29	nw.	28	7	13	10	5.6	5.5
Northern Slope.							32.7	0.0										74	0.42	− 0.1										5.1	
Havre	2,505	46	53	27.39	30.12	+ .09	26.6	− 3.3	75	2	37	−29	18	16	43	23	20	80	0.50	− 0.1	7	7,257	sw.	48	sw.	9	11	13	6	4.9	4.8
Miles City	2,371	42	50	27.53	30.12	+ .05	31.2	− 0.1	74	7	40	−12	18	22	42	27	25	86	0.26	− 0.1	7	4,437	s.	36	sw.	10	16	10	4	4.0	1.4
Helena	4,110	88	94	25.84	30.17	+ .07	27.8	− 3.7	65	7	36	−16	18	20	29	23	18	74	1.09	+ 0.4	10	4,517	sw.	45	w.	30	4	9	17	7.3	16.7
Kalispell	2,965	45	51	26.96	30.10	+ .03	28.8	......	64	3	36	−10	18	22	35	26	24	83	3.13	......	14	3,447	w.	30	nw.	14	4	6	20	7.6	24.5
Rapid City	3,234	46	50	26.64	30.12	+ .01	34.0	− 0.9	72	27	45	− 3	17	23	45	28	21	68	T.	− 0.4	0	6,005	nw.	36	n.	16	13	10	7	4.1	T.
Cheyenne	6,088	56	64	24.02	30.11	+ .04	36.6	+ 2.4	67	7	49	− 5	17	24	34	28	20	57	0.79	+ 0.5	5	7,120	nw.	56	w.	11	13	14	3	4.2	7.2
Lander	5,372	26	36	24.66	30.15	+ .05	34.0	+ 2.4	67	7	49	− 4	18	19	40	26	21	69	0.01	− 0.6	1	2,792	ne.	32	sw.	11	10	15	5	4.5	0.1
North Platte	2,821	43	52	27.15	30.15	+ .07	38.4	+ 3.2	77	7	52	0	18	25	50	31	26	72	0.28	− 0.1	4	6,009	nw.	34	nw.	12	17	6	7	4.4	
Middle Slope.							42.4	+ 1.1										69	0.58	− 0.4										4.3	
Denver	5,291	79	151	24.75	30.10	+ .04	41.1	+ 3.1	74	27	55	3	18	28	40	32	25	62	0.07	− 0.6	2	5,698	s.	45	nw.	11	15	12	3	4.0	1.5
Pueblo	4,685	80	86	25.33	30.12	+ .07	40.3	+ 1.5	77	7	56	1	18	25	47	31	24	63	0.15	− 0.2	3	3,542	nw.	37	w.	11	16	11	3	3.7	2.0
Concordia	1,398	42	47	28.64	30.15	+ .07	40.4	+ 0.4	64	7	49	10	18	32	34	35	31	79	1.07	+ 0.2	4	5,174	se.	28	s.	11	12	11	7	4.4	0.3
Dodge	2,509	44	54	27.48	30.14	+ .07	42.5	+ 2.3	77	15	55	5	18	30	47	34	28	70	1.03	+ 0.5	5	7,318	n.	38	nw.	10	11	7	12	5.3	0.1
Wichita	1,358	78	86	28.68	30.15	+ .07	42.8	0.0	76	15	52	12	18	34	37	37	33	76	0.75	− 0.2	3	6,762	n.	30	s.	10	19	4	7	4.4	
Oklahoma	1,214	79	86	28.81	30.12	+ .04	47.1	− 0.8	84	15	57	13	18	37	38	39	32	63	0.40	− 2.1	3	8,343	n.	42	nw.	11	14	11	5	4.1	
Southern Slope.							50.4	+ 2.1										62	0.02	− 1.0										2.7	
Abilene	1,738	45	54	28.28	30.11	+ .04	53.9	+ 1.9	85	15	66	18	18	42	37	45	39	68	0.05	− 1.3	1	5,652	se.	30	n.	11	22	7	1	2.4	
Amarillo	3,676	10	49	26.31	30.09	+ .04	46.8	+ 2.3	81	8	61	11	18	33	42	35	26	56	0.00	− 0.7	0	9,360	sw.	48	n.	10	23	7	0	3.0	
Southern Plateau.							53.3	+ 3.9										38	T.	− 0.6										2.3	
El Paso	3,762	10	110	26.25	30.05	+ .05	54.4	+ 2.9	81	7	72	24	18	37	45	39	24	39	0.00	− 0.5	0	5,612	nw.	44	sw.	10	23	6	1	1.7	
Santa Fe	7,013	47	50	23.31	30.10	+ .07	43.4	+ 5.8	65	7	55	8	18	32	30	30	16	37	0.00	− 0.8	0	4,084	se.	26	sw.	10	26	4	0	1.1	
Flagstaff	6,907	12	25	23.42	30.08	+ .06	40.4	+ 1.8	68	22	58	11	17	23	48	32	......	......	0.00	− 1.0	0	......	nw.	......	......	......	14	15	1	3.0	
Phoenix	1,108	50	56	28.84	30.00	+ .02	62.4	+ 3.9	86	27	79	40	17	46	39	47	33	40	0.00	− 0.5	0	2,353	e.	18	e.	18	21	5	4	2.3	
Yuma	141	16	46	29.82	29.97	− .01	65.7	+ 3.4	87	6	80	42	20	51	38	50	35	38	0.00	− 0.3	0	3,620	n.	26	n.	17	25	4	1	1.2	
Independence	3,910	51	58	26.04	30.04	− .01	53.4	+ 5.6	75	4	66	30	27	41	34	40	24	34	T.	− 0.2	0	4,440	nw.	39	w.	14	13	7	10	4.3	
Middle Plateau.							41.8	+ 2.2										60	1.07	0.0										4.3	
Carson City	4,720	82	92	25.32	30.07	− .04	44.1	+ 2.7	70	2	57	15	9	32	42	38	32	66	0.81	− 0.7	6	7,012	sw.	64	w.	11	12	6	12	4.8	
Winnemucca	4,344	59	70	25.66	30.09	− .05	41.0	+ 3.9	68	3	54	11	9	28	45	35	29	67	1.24	+ 0.7	5	7,578	ne.	60	sw.	11	12	3	15	5.2	
Modena	5,479	10	43	24.69	30.11	+ .03	40.1	......	68	22	55	13	17	25	43	31	20	51	0.00	......	0	6,943	w.	42	sw.	11	15	11	4	3.1	
Salt Lake City	4,366	105	110	25.71	30.14	+ .02	42.0	+ 2.2	70	7	52	17	17	32	32	34	28	64	2.21	+ 0.8	8	3,896	se.	57	nw.	12	14	5	11	5.0	7.0
Grand Junction	4,608	43	51	25.47	30.11	+ .03	40.3	+ 0.2	72	14	55	12	17	26	36	32	23	53	0.01	− 0.6	1	2,913	nw.	25	w.	8	16	10	4	3.6	T.
Northern Plateau.							40.6	+ 2.0										74	2.27	+ 0.8										7.3	
Baker City	3,471	53	59	26.48	30.11	− .05	38.6	+ 1.8	65	3	45	16	17	32	27	33	27	69	2.42	+ 1.5	12	4,311	se.	36	sw.	11	4	4	22	8.2	9.8
Boise	2,739	61	68	27.25	30.16	− .01	43.0	+ 4.5	72	2	52	20	10	34	38	37	31	70	1.52	+ 0.2	13	3,420	se.	33	sw.	14	7	8	15	6.7	4.7
Lewiston	757	52	61	29.22	30.04	− .08	44.0	+ 1.5	69	1	51	29	18	37	28	......	......	......	2.34	+ 0.5	14	2,879	e.	40	w.	11	3	14	13	7.1	2.3
Pocatello	4,482	46	54	25.51	30.13	− .01	38.9	+ 5.9	65	2	48	12	17	30	36	33	26	60	1.08	− 0.2	11	7,164	e.	36	sw.	7	10	9	11	5.4	11.7
Spokane	1,929	101	110	27.98	30.08	− .02	36.8	− 1.0	70	1	42	13	17	31	35	34	31	83	3.12	+ 1.4	10	4,302	s.	24	w.	9	1	3	26	9.0	11.8
Walla Walla	1,000	65	71	28.96	30.05	− .08	42.1	− 0.9	74	4	48	23	18	36	29	40	38	88	3.15	+ 1.7	16	4,143	s.	46	sw.	11	2	13	15	7.2	T.
N. Pac. Coast Reg.							46.0	+ 0.6										85	10.37	+ 3.5										8.7	
North Head	211	11	56	29.70	29.92	− .13	47.7	− 0.5	66	30	52	35	15	44	17	46	44	87	9.63	+ 1.1	25	17,099	se.	90	se.	8	0	5	25	9.2	
Port Crescent	259	12	29	29.61	29.90	− .10	42.4	+ 0.1	56	3	47	29	23	37	15	......	......	......	10.48	+ 4.1	25	4,210	sw.	44	ne.	11	1	7	22	8.5	1.2
Seattle	123	114	151	29.84	29.97	− .07	46.0	+ 0.7	66	1	50	33	17	42	18	43	41	83	7.34	+ 1.7	22	6,120	se.	40	se.	14	2	9	19	7.9	0.9
Tacoma	213	113	120	29.72	29.95	− .09	45.3	+ 1.1	69	1	51	28	17	40	26	......	......	......	10.00	+ 3.9	23	4,499	sw.	34	s.	14	0	3	27	9.1	1.2
Tatoosh Island	86	7	57	29.75	29.85	− .12	45.8	− 0.6	57	4	50	34	17	42	14	44	42	86	15.32	+ 3.2	27	17,820	e.	78	e.	18	1	2	27	9.5	T.
Portland, Oreg.	154	68	96	29.83	29.99	− .11	46.2	+ 0.6	65	1	51	31	24	41	22	43	41	83	10.71	+ 4.9	23	4,738	se.	34	w.	11	2	5	23	8.7	
Roseburg	518	56	67	29.46	30.03	− .09	48.3	+ 3.1	76	3	54	33	16	42	25	46	44	87	9.11	+ 5.4	23	2,454	s.	28	sw.	14	4	6	20	7.7	0.2
Mid. Pac. Coast Reg.							54.5	+ 1.0										82	6.18	+ 2.9										6.6	
Eureka	62	62	80	30.00	30.07	− .04	53.2	+ 3.1	69	3	59	37	16	48	18	51	48	85	10.79	+ 5.4	17	5,174	s.	37	s.	15	4	6	20	7.7	
Mount Tamalpais	2,375	11	18	27.62	30.10	+ .01	50.7	......	66	1	55	37	10	46	17	46	43	80	8.67	......	13	14,210	nw.	65	nw.	9	11	8	11	5.5	
Red Bluff	332	50	56	29.72	30.07	− .04	53.6	− 0.3	75	1	61	36	16	46	28	49	46	78	7.99	+ 4.9	12	4,927	se.	36	se.	11	10	8	12	5.8	
Sacramento	69	106	117	30.02	30.09	.00	54.9	+ 1.4	72	2	62	36	9	47	29	51	48	82	3.44	+ 1.3	9	5,852	se.	40	se.	20	8	8	14	6.2	
San Francisco	155	161	167	29.96	30.13	+ .04	56.6	+ 0.3	69	6	61	46	16	52	13	53	51	84	4.25	+ 1.6	11	5,605	w.	32	sw.	14	9	6	15	6.6	
Point Reyes Light	490	7	50	29.53	30.05	......	54.4	+ 0.6	68	27	58	44	16	51	18	......	......	......	4.45	+ 1.4	13	14,450	nw.	75	nw.	7	5	8	17	7.3	
Southeast Farallon	30	9	17	30.07	30.00	......	55.7	......	61	9	58	49	15	54	9	......	......	......	5.55	......	14	11,097	nw.	55	nw.	7	7	7	16	6.9	
S. Pac. Coast Reg.							60.1	+ 2.6										71	0.29	− 1.0										4.1	
Fresno	330	67	70	29.74	30.11	+ .05	55.2	− 0.2	79	1	65	32	16	46	34	49	44	71	0.68	− 0.5	5	3,225	nw.	24	nw.	7	9	8	13	5.9	
Los Angeles	338	116	123	29.68	30.04	+ .02	63.5	+ 4.3	90	26	75	41	16	52	34	53	46	65	0.00	− 1.4	0	3,334	w.	18	w.	2	15	14	1	3.6	
San Diego	87	94	102	29.93	30.02	.00	61.6	+ 3.0	84	26	69	45	16	54	31	55	51	76	T.	− 0.8	0	3,658	nw.	21	nw.	14	23	5	2	2.7	
San Luis Obispo	201	46	48	29.90	30.12	+ .06	60.2	+ 3.2	87	30	71	38	18	50	46	52	47	71	0.48	− 1.5	6	3,796	n.	20	n.	30	15	6	9	4.2	
West Indies.																															
Basseterre	29	41	54	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	
Bridgetown	30	57	65	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	
Cienfuegos	52	62	67	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	
Havana	57	87	105	29.94	30.00	+ .01	72.9	− 2.4	86	4	78	56	29	68	19	......	......	......	5.85	+ 2.8	10	8,376	e.	52	e.	21	11	14	5	4.7	
Kingston	286	41	55	29.59	29.88	......	78.4	......	90	8	86	59	23	71	24	......	......	......	1.19	......	6	......	nw.	......	......	......	1	20	9	6.8	
Puerto Principe	352	55	62	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	
San Juan	82	48	90	29.80	29.88	− .02	78.1	− 0.5	87	11	84	70	28	72	14	73	71	80	6.41	− 0.1	19	5,856	e.	28	e.	18	10	13	7	4.8	
Santiago de Cuba	82	46	52	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	
Santo Domingo	57	37	44	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	

* More than one date.

TABLE II.—*Climatological record of voluntary and other cooperating observers, November, 1903.*

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
	°	°	°	Ins.	Ins.
Alabama.					
Anniston	82[d]	18[d]	52.6[d]	0.91	
Ashville	77	17	48.0	1.57	
Benton				0.65	
Bermuda	82	20	54.4	1.46	
Bridgeport				4.55	
Burkeville				0.70	
Calera				0.50	
Camphill				2.20	
Citronelle	82	24	57.0	1.73	
Clanton	82	18	52.2	0.30	
Cordova	81	16	49.3	1.27	
Daphne	80	25	58.4	1.15	
Demopolis				0.92	
Dothan	83	24	56.6	5.79	
Eufaula	79	23	51.8	3.29	
Eutaw [1]	84	21	51.2		
Evergreen	85	22	51.7	2.49	
Flomaton	84	21	56.0	3.83	
Florence *a*				3.12	
Florence *b*	77	15	49.6	2.53	
Fort Deposit	85	20	51.4	1.85	
Gadsden	79	18	49.2	2.20	
Goodwater	77	18	49.4	1.06	
Greensboro	79	21	52.4	0.54	
Greenville				2.07	
Haleysville				4.60	
Helena				1.10	
Highland Home	79	22	53.8	3.68	
Letohatchie				1.99	
Livingston	79	20	48.7	3.02	
Lock No. 4	79	19	49.8	1.10	
Madison Station	75	16	50.8	5.32	
Maplegrove	77	17	46.8	2.77	
Marion	80	21	51.6	1.25	
Milstead				1.47	
Newbern	82	19	52.4	0.95	
Notasulga				1.27	
Oneonto	77	15	48.0	0.89	
Opelika	77	21	49.4	0.59	
Ozark	79[e]	22[e]	47.6[e]	3.44	
Prattville	79	17	51.2	0.58	
Pushmataha	80	19	52.4	1.44	
Riverton	79	12	48.8	3.88	
Scottsboro	74	18	48.4	1.69	
Selma	82	21	55.8	0.17	
Spring Hill	80	26	57.6		
Talladega	80	20	52.4	0.91	
Tallassee				1.62	
Thomasville	79	21	52.4	0.72	
Tuscaloosa	78	19	48.8	1.00	
Tuskegee	81	21	53.8	0.66	
Union Springs	79	20	52.3	1.90	
Uniontown	83	16	52.4	1.17	
Valleyhead	78	12	47.2	3.83	
Verbena				0.20	
Wetumpka	84	19	53.6	0.24	
Alaska.					
Copper Center	35	−37	−3.6	0.20	3.0
Fort Liscum	42	4	23.3	5.62	64.0
Killisnoo	50	15	33.5	3.65	4.0
Orca	47	15	31.2	13.24	38.0
Sitka	54	16	36.4	6.50	6.5
Skagway	44	10	28.1	1.60	3.5
Arizona.					
Agua Caliente	89	30	62.2	0.00	
Allaire Ranch				0.00	
Arizona Canal Co's Dam	87	40	63.8	0.00	
Ashfork	80	12	45.4	0.00	
Aztec	91	37	63.2	0.00	
Benson	88	30	59.2	0.00	
Bowie	84	24	54.8	0.00	
Casagrande	90	37	63.0	0.00	
Champie Camp	90	33	61.3	0.00	
Cochise *[1]	76	32	53.6	0.00	
Congress	83	43	64.8	0.00	
Dragoon *[1]	85	35	51.6	0.00	
Dudleyville	89	26	58.0	0.00	
Duncan	82	15	49.2	0.00	
Fort Apache	79	19	48.6	0.00	
Fort Defiance	65	8	38.2	0.00	
Fort Grant	84	34	62.5	0.00	
Fort Huachuca	80	37	58.6	0.00	
Fort Mohave	86	38	61.6	0.00	
Grand Canyon	69	31	48.7	0.00	
Greaterville [b]	79	35	56.9	0.00	
Holbrook	78	16	45.3	0.00	
Jerome	71	37	56.0	0.00	
Kingman	77	34	56.9	0.00	
Maricopa	86	31	58.4	0.00	
Mellen	85	39	61.5	0.00	
Mesa	89	34	62.0	0.00	
Mesa (near)		32		0.00	
Mohawk Summit *[1]	89	53	65.4	0.00	
Natural Bridge				0.00	
Nogales	87	32	57.8	0.00	
Oracle	77	43	58.8	0.00	
Oro				0.00	
Parker	91	32	62.4	0.00	
Arizona—Cont'd.					
Phoenix	85	35	60.2	0.00	
Pinal Ranch				0.00	
Prescott	73	15	45.7	0.00	
St. Johns	77	15	44.6	0.00	
San Carlos	85	27	54.3	0.00	
Sentinel *[5]	88	49	67.6	0.00	
Signal [j]	88	29	59.2	0.00	
Superstition				0.00	
Taylor	75	16	44.2	0.00	
Thatcher	83	23	53.6	0.00	
Tombstone	82	36	59.6	0.00	
Tonto	79	31	55.6	0.00	
Tucson	88	35	60.1	0.00	
Upper San Pedro	84	26	54.0	0.00	
Vail *[5]	80	49	69.7	0.00	
Walnutgrove				0.00	
Wilcox	80	22	50.8	0.00	
Williams	75	18	47.6	0.00	
Yarnell				0.00	
Young	81	19	49.0	0.00	
Arkansas.					
Alco	75	13	47.1	0.94	T.
Amity	80	12	50.0	0.21	
Arkadelphia	81	11	48.4	0.10	
Arkansas City				0.70	
Beebranch	78	12	46.6	0.55	
Blanchard	82	13	50.2	0.41	
Brinkley	78	10	46.6	0.53	
Camden *a*				0.53	
Camden *b*	82	20	48.9	0.37	
Conway	78	14	46.7	0.43	1.5
Corning	77	13	43.8	0.57	1.6
Dallas	75	13	49.5	0.08	
Dardanelle				0.18	
De Queen	81	14	49.1	0.10	
Des Arc	81	13	48.8	0.70	
Dutton	68[e]	10[d]	45.3[d]	0.60	
Eureka Springs	73	12	45.0	0.81	
Fayetteville	78	10	44.6	0.41	
Forrest City	77[d]	12[e]	49.3[d]	0.25	
Fulton				0.13	
Hardy	85	13	46.8	0.74	0.3
Heber	80	11	46.6	0.41	T.
Helena *a*				0.88	
Helena *b*	80	17	49.6	0.86	
Jonesboro	79	13	47.4	1.82	
Lacrosse [e]	75	15	43.8	1.80	T.
Lake Village [e]	89	14	53.2	0.83	
Lonoke	78	12	47.8	0.05	
Lutherville	75	11	46.8	0.78	
Malvern	80	15	48.9	T.	
Marvell	81	11	48.9	0.86	
Mossville	68	10	42.8	1.21	
Mount Nebo	74	13	47.8	0.32	
New Gascony	80	16	50.1	0.35	
Newport *a*				1.07	
Newport *b*	80	12	47.4	1.13	
Oregon	76	10	43.7	1.01	
Ozark	79	16	47.9	0.91	
Paragould	76	17	47.4	1.85	
Perry	80	13	48.3	0.05	
Pinebluff	80	14	47.3	0.51	
Pocahontas	77	11	45.6	0.78	0.5
Pond	72	7	44.0	0.87	T.
Prescott	84	19	51.0	0.06	
Princeton	79	11	49.2	0.27	
Rison	79	8	46.2	0.47	
Rosadale	84	14	50.6	T.	
Russellville	77	14	44.6	0.65	
Silversprings	74	11	45.6	0.49	
Spielerville	80	16	48.5	0.37	
Stuttgart	80	10	49.6	0.54	
Texarkana	88	15	52.6	0.00	
Warren	82	12	50.6	1.34	
Washington	83	16	52.2	0.05	
Wiggs	78	10	47.8	0.15	
Winchester [e]	81	21	52.0	1.15	
Winslow	68	9	43.0	0.51	T.
Witts Springs	77	2	41.6	0.96	T.
California.					
Angiola	87	27	56.6	T.	
Azusa	90	40	63.4	0.00	
Bagdad	84	42	62.6	0.00	
Bakersfield	82	30	55.2	0.15	
Ballast Point L. H.				0.00	
Barstow	81	31	56.5	0.00	
Bear Valley				20.36	
Berkeley	64	39	53.8	5.89	
Bishop	80	21	50.2	0.00	
Boca *[1]	76	18	39.7	0.62	T.
Bodie	67	5	37.6	0.55	3.0
Branscomb	80	27	50.0	37.17	
Brush Creek	69	27	48.5	23.89	
Butte Valley				15.90	
Caliente *[1]	84	47	64.3	0.16	
Campbell	70	31	54.4	1.88	
Campo				0.00	
Cape Mendocino L. H				8.60	
California—Cont'd.					
Cedarville	75	12	40.1	4.46	4.0
Chico	81	31	54.2	7.23	
Cisco *[1]	53	18	38.5	16.90	16.0
Claremont	90	38	61.5	0.00	
Cloverdale	76	33	54.6	10.11	
Colusa	73	34	54.4	3.60	
Corning *[1]	82	28	60.4	6.25	
Coronado	86	43	59.8	T.	
Crescent City	65	34	52.0	21.73	
Crescent City L. H				20.53	
Cuyamaca	67	26	46.6	0.04	
Delano *[1]	75	35	54.6	0.30	
Delta [1]*	78	31	52.1	15.48	
Dobbins	79	35	55.8	12.41	
Drytown	73	33	52.4	6.38	
Dunnigan *[1]	76	38	51.1	4.83	
E. Brother L. H				4.25	
Elcajon	93	36	60.8	0.00	
Elmdale	86	35	57.1	1.37	
Elsinore	96	29	60.2	0.00	
Escondido	86	27	54.6	0.03	
Fallbrook	86	36	59.2	0.05	
Fordyce Dam				19.47	11.0
Fort Bragg				5.98	
Fort Ross	66	38	53.4	15.97	
Foster				0.00	
Georgetown	75	30	51.7	17.71	
Gilroy (near)	77	30	55.2	2.24	
Greenville				12.17	
Hanford	80	28	54.6	0.47	
Healdsburg	75	32	54.2	14.53	
Hiland Springs				11.38	
Hollister	75	30	54.4	1.81	
Humboldt L. H				8.90	
Idylwild	78	18	50.1	0.00	
Imperial	88	34	61.8	0.00	
Indio	97	36	62.0	0.00	
Ione	88	32	54.9	6.42	
Iowa Hill *[1]	70	36	52.5	13.88	
Jamestown	80	31	50.5	4.95	
Jolon				0.61	
Kennedy Gold Mine	70	28	47.3	7.20	
Kernville				0.00	
Kentfield	67	35	54.5	14.61	
King City	81	26	57.8	0.26	
Laguna Valley				0.00	
Lakeport (near)	69	39	52.8	5.29	
Laporte	62	20	41.9	27.64	2.4
Legrande	80	30	53.4	1.11	
Lemoncove	90	34	59.5	0.32	
Lick Observatory	65	29	48.2	7.67	
Lime Point, L. H				2.34	
Livermore	81	31	55.6	2.16	
Lodi	74	31	54.2	3.58	
Los Gatos	74	38	54.4	4.94	
Mammoth	87	42	65.5	0.00	
Mare Island L. H				3.17	
Marysville	76	34	54.4	4.85	
Meadow Valley				24.00	3.0
Merced	82	26	50.7	1.40	
Mercury				14.26	
Mills College				7.02	
Milo				0.60	
Milton (near)	74	34	54.8	4.65	
Modesto *[1]	80	40	56.7	2.64	
Mohave	85	24	56.8	0.00	
Mokelumne Hill				7.48	
Monterio	82	32	58.0	1.55	
Monterey *[1]	69	37	55.5	2.17	
Napa	71	33	52.8	4.25	
Needles	86	55	69.6	0.00	
Nevada City	76	26	49.8	13.48	
Newcastle	78	32	52.0	7.65	
Newman	78	31	55.8	1.06	
Niles	72	36	55.6	3.52	
Nimshew	68	26	48.8	25.85	
North Bloomfield	74	26	49.5	15.28	
North San Juan	76	24	51.2	14.13	
Oakland	66	41	55.9	5.22	
Ontario	83	43	61.8	0.00	
Ontario (near)	85	38	60.6	0.00	
Orleans	74	34	53.8	18.41	
Oroville (near)	82	35	54.8	6.56	
Palermo	77	29	52.2	6.10	
Paso Robles	83	29	55.4	0.48	
Peachland *[6]	69	37	55.2	13.98	
Piedras Blancas L. H				1.22	
Pigeon Point L. H				3.39	
Pilot Creek				20.78	
Pine Crest	87	47	64.5	0.08	
Pino Grande	70	26	47.4	22.43	
Placerville	70	30	51.0	10.26	
Point Ano Nuevo L. H				5.05	
Point Arena L. H				11.78	
Point Bonita L. H				6.87	
Point Conception L. H				0.31	
Point Fermin L. H				0.00	
Point George L. H				11.23	

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
California—Cont'd.	°	°	°	*Ins.*	*Ins.*
Point Hueneme L. H.				0.00	
Point Lobos	62	44	54.8	2.97	
Point Loma L. H.				0.00	
Point Montara L. H.				6.21	
Point Pinos L. H.				2.31	
Point Sur L. H.				3.70	
Porterville	82	33	56.6	0.09	
Poway				0.02	
Quincy	66	25	43.7	14.08	
Redding	75	36	54.0	13.97	
Redlands	84	40	61.3	0.00	
Reedley	80	30	55.6	0.44	
Represa	70	36	55.4	6.42	
Riovista	72	32	54.8	3.18	
Riverside	87	35	59.1	0.00	
Roe Island L. H.				2.11	
Rohnerville				10.06	
Rosewood	75	29	51.1	6.98	
Sacramento	69	34	53.6	3.89	
Salinas	77	30	56.6	0.96	
Salton	86	39	62.8	0.00	
San Bernardino	90	33	60.0	0.00	
San Jacinto	86	36	61.7	0.00	
San Jose	70	35	55.9	0.99	
San Leandro	69	36	54.0	5.78	
San Luis L. H.				0.66	
San Mateo*[1]	69	40	56.5	5.18	
San Miguel*[1]	73	27	54.3	0.37	
San Rafael	70	32	54.6	9.51	
Santa Barbara	88	44	62.1	0.05	
Santa Barbara L. H				0.03	
Santa Clara				1.70	
Santa Clara College	71	31	55.6	1.85	
Santa Cruz	75	32	54.2	8.59	
Santa Cruz L. H				7.40	
Santa Maria	82	38	60.3	0.19	
Santa Monica	89	45	60.8	0.00	
Santa Paula	82[c]	30[c]	61.4[c]	0.00	
Santa Rosa	77	32	53.6	9.65	
Sausalito				7.22	
Shasta	76	35	52.0	19.67	
Sierra Madre	84	44	62.7	0.00	
Sisson	65	16	41.8	10.71	T.
Sonoma				6.38	
Sonora				4.98	
S. E Farallon L. H				4.35	
Stockton	70	33	52.7	3.06	
Storey	80	30	54.4	0.95	
Summerdale	70	27	47.8	5.90	
Susanville	66	17	41.1	5.26	
Tehama	78	37	56.2	5.86	
Tejon Ranch	76	37	56.8	0.99	
Trinidad L. H				12.82	
Truckee	68	28	47.1	8.21	
Tulare c	88	28	56.6	0.39	
Tustin	84	59	67.6	0.03	
Ukiah	75	30	52.1	11.93	
Upland	82	38	59.5	0.00	
Upperlake	78	25	50.0	9.44	
Upper Mattole*[1]	71	33	50.5	29.77	
Vacaville*[1]	80	37	55.8	5.88	
Visalia	85	30	55.0	0.35	
Volcano Springs	93	39	64.4	0.00	
Wasco	82	29	55.6	0.25	
Weldon				0.00	
Westpoint				9.52	
Wheatland	73	33	52.9	4.35	
Willits	72	32	52.8	20.72	
Willow	74	34	54.0	4.91	
Yerba Buena L. H.				4.10	
Zenia	74	26	47.9	21.63	
Colorado.					
Alford	66	−8	37.6	0.26	3.0
Antelope Springs	59	−7	24.8	0.50	8.0
Ashcroft	61	−9	29.8	1.14	13.7
Blaine	83	−4	43.4	0.21	1.0
Boulder	75	2	42.8	0.15	2.2
Boxelder				0.33	4.0
Breckenridge	60	−17	30.8	2.29	32.0
Buenavista				T.	T.
Burlington				0.40	0.5
Canyon	76	2	42.7	0.08	3.0
Castlerock	78	−5	39.2	0.15	2.0
Cedaredge	70	6	40.7	T.	
Cheesman	70	0	40.0	0.17	3.0
Cheyenne Wells	77	−6	41.4	0.71	1.0
Clearview	62	2	36.6	0.07	1.0
Collbran	68	1	36.8	0.09	1.2
Colorado Springs	71	−5	40.4	0.25	3.0
Durango	68	7	40.6	0.00	
Fort Collins	71	−10	36.0	0.14	1.2
Fort Morgan	70[j]	−13[k]		0.23	4.0
Fowler				0.27	3.5
Fox	79	−12	38.8	0.28	0.5
Fruita	68[c]	6[c]	36.0[c]	T.	T.
Garnett	65	−4	30.8	T.	
Gilman				0.99	11.5
Gleneyre	74	−11	39.2	0.42	4.0

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Colorado—Cont'd.	°	°	°	*Ins.*	*Ins.*
Glenwood	66	0	35.4	0.02	0.2
Greeley	74	−13	36.5	0.30	1.5
Grover				0.25	3.0
Gunnison	65	−8	30.4	0.02	0.5
Hamps	74	−9	37.0	0.09	1.8
Hoehne	78	−2	40.8	0.27	3.0
Holly	81	0	43.7	0.29	0.2
Husted	69	−15	35.9	0.40	6.8
Lake Moraine	54	−11	32.4	0.30	3.2
Lamar	81	−4	42.6	0.92	2.0
Laporte				0.10	1.5
Las Animas	77	−14	38.6	0.33	4.0
Leadville (near)	57	−4	30.9	0.87	9.0
Leroy	75	−5	38.0	0.06	1.0
Longs Peak	55	−14	31.5	0.20	3.4
Mancos	67	5	39.2	0.00	
Marshall Pass				1.07	16.0
Meeker	67	−5	34.2	0.47	
Montrose				T.	T.
Moraine	58	0	36.3	0.64	6.8
Pagoda	68	0	36.1	0.46	2.0
Parachute	70	6	39.8	0.01	0.2
Platte Canon				0.13	1.5
Rangely	72	0	35.0	0.10	1.5
Rockyford	76	−12	39.1	0.26	4.0
Rogers Mesa	76	4	39.6	0.00	
Ruby				1.44	20.0
Saguache	61	1	35.2	0.00	
Salida	67	−2	39.0	0.00	
San Luis	67	−8	36.3	0.00	
Santa Clara	68	−4	38.4	0.05	1.0
Sapinero				0.13	2.0
Silt	68	5	39.0	0.05	......
Sugar Loaf	63	−3	35.4	0.78	12.0
Trinidad	74	6	44.2	0.09	2.0
Vilas				0.02	T.
Wagon Wheel	63	−6	29.6	0.00	
Wallet				0.13	2.0
Waterdale	73	−7	38.8	0.18	
Westcliffe	64	−3	35.0	0.02	0.4
Whitepine	54	−13	27.0	0.42	9.1
Wray	81	−9	39.6	0.25	0.5
Yuma				0.36	1.0
Connecticut.					
Bridgeport	74	13	39.5	1.83	
Canton	71	4	34.2	3.21	T.
Colchester	74	9	38.5	1.89	0.5
Falls Village				2.42	T.
Hartford	69	11	37.0	2.84	T.
Hawleyville	68	8	37.0	2.07	
New London	70	13	40.4	1.29	T.
North Grosvenor Dale	73	4	35.5	2.05	
Norwalk	71	7	36.4	1.38	
Southington	71	7	36.3	2.15	T.
South Manchester				2.24	
Storrs	69	7	35.8	1.95	0.2
Voluntown	73	4	38.0	1.92	1.5
Waterbury	75	8	37.0	2.30	T.
West Cornwall	70	7	35.6	3.10	1.5
West Simsbury				3.09	T.
Delaware.					
Delaware City				0.69	T.
Milford	76	17	44.5	1.36	0.2
Millsboro	75	15	42.8	2.50	T.
Newark	76	12	40.2	0.56	•
Seaford	79	17	42.6	1.71	0.2
District of Columbia.					
Distributing Reservoir*[b]	71	21	42.9	0.80	......
Receiving Reservoir*[b]	70	18	41.0	0.94	......
West Washington	74	17	42.0	0.93	0.7
Florida.					
Apalachicola	80	31	61.7	4.34	
Archer	85	20	60.4	0.40	
Avon Park	88	30	66.2	4.69	
Bartow	87	28	64.2	1.49	
Bonifay	83	23	57.9	7.56	
Brooksville	90	24	64.2	1.56	
Carrabelle	80	31	60.8	0.70	
Clermont	86	30	65.6	2.05	
De Funiak Springs	85	21	57.6	4.56	
Eustis	88	26	63.7	1.54	
Federal Point	85	30	61.8	1.18	
Fernandina	82	28	60.7	4.32	
Fort George*[1]	82	28	62.2	......	
Fort Meade	88	26	65.8	2.50	
Fort Pierce	85	34	67.2	8.36	
Flamingo	89	42	70.9	T.	
Gainesville	86	22	61.2	0.25	
Grasmere	84	26	62.2	......	
Huntington	85	27	61.0	1.45	
Hypoluxo				2.76	
Inverness	85	20	60.4	0.94	
Jasper	87	19	59.4	1.47	
Johnstown	87[g]	19[g]	60.4[g]	0.46	
Kissimmee	84	30	64.4	3.56	
Lake City	85	20	60.4	0.83	
Macclenny	87[f]	20[f]	60.6[f]	1.05	
Madison	85	25	60.6	1.50	

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Florida—Cont'd.	°	°	°	*Ins.*	*Ins.*
Malabar	85	32	66.9	3.38	
Manatee	88	29	65.1	2.70	
Marco	89	36	68.0	T.	
Marianna	80	23	65.6	7.26	
Merritt Island	88	34	66.2	2.67	
Miami	88	38	71.6	3.70	
Micanopy	89	24	60.0	......	
Middleburg	87	17	59.5	1.23	
Molino	87	22	57.6	9.28	
Myers	85	35	65.8	2.02	
New Smyrna	81	30	64.2	2.84	
Nocatee	89	28	66.8	2.83	
Ocala	88	22	62.0	1.20	
Orange City	93	25	63.8	2.00	
Orange Home	91	22	63.5	1.49	
Orlando	88	28	64.7	2.71	
Pinemount	85	19	59.6	0.65	
Plant City	84[h]	25	62.7[d]	2.35	
St. Andrews	80	22	58.2	5.71	
St. Augustine	86	28	62.1	3.53	
St. Leo	87	26	63.3	2.93	
Stephensville	87	25	58.0	T.	
Sumner	88	26	60.2	0.73	
Switzerland	84	26	60.0	1.49	
Tallahassee	81	27	59.2	5.14	
Tarpon Springs	88	26	63.5	2.57	
Wausau		21		6.71	
Wewahitchka	85	25	57.7	3.55	
Georgia.					
Abbeville				3.62	
Adairsville	77	19	47.7	1.12	T.
Albany	88[h]		57.2[i]	3.31	
Allapaha	83[c]	20[c]	56.5[c]	1.85	
Americus	79	22	53.2	4.73	
Athens	74	19	48.7	1.76	
Blakely	85	24	55.6	6.85	
Bowersville	78	16	49.6	1.65	0.2
Butler				3.04	
Camak	79	18	50.2	1.91	T.
Canton				2.96	
Carlton				1.24	
Clayton	71	14	45.2	2.89	
Columbus	82	23	54.4	1.70	
Coney	83	19	54.1	5.08	
Covington	76	17	49.8	0.99	T.
Dahlonega	72	13	46.2	1.76	T.
Dawson	84	20	55.2	6.18	
Diamond	77	11	46.2	2.15	
Douglas	82	19	56.6	1.70	
Dublin				4.09	
Dudley	80	19	54.0	3.60	
Eatonton	77	19	52.0	1.44	
Elberton	78	20	50.9	0.55	
Experiment	77	17	49.8	1.06	
Fitzgerald	82[c]	18[d]	53.0[b]	3.77	
Fleming	87	17	56.6	1.00	
Forsyth	78	19	52.3	1.55	
Gainesville	72	17	47.0	3.10	T.
Gillsville	76	16	49.5	2.43	
Greenbush	80	18	48.6	2.22	T.
Greensboro	79	18	49.8	1.51	
Griffin	77	18	50.7	1.07	
Harrison	80	20	52.8	3.61	
Hawkinsville	80	19	52.5	3.94	
Hephzibah				1.50	T.
Jesup	86	18	56.6	1.79	
Lost Mountain	75	16	48.7	2.97	T.
Louisville	78	18	52.4	2.39	
Lumpkin	84	20	55.0	3.98	
Marshallville	77[f]		53.4[g]	4.24	
Mauzy	84	19	57.4	3.48	
Milledgeville	78	19	50.8	1.76	
Millen	82	23	54.4	1.44	
Monticello	79	19	51.4	1.20	
Morgan	80	20	53.8	5.90	
Naylor	85	19	57.0	0.30	
Newnan	50	17	48.8	1.59	
Oakdale				3.49	
Oakfield				5.73	
Point Peter	78	13	50.1	1.34	T.
Poulan	83	18	55.2	3.94	
Putnam	81	21	53.0	3.98	
Quitman	81	24	56.7	1.64	
Ramsey	75	16	49.2	3.07	
Resaca				1.66	
Rome	77	18	48.4	1.74	
St. Marys	83	20	58.1	1.48	
Statesboro	83	20	55.4	3.69	
Talbotton	79	20	51.7	1.65	
Tallapoosa	80	16	45.8	1.88	
Thomasville	81	22	57.6	2.86	
Toccoa	78	15	48.2	2.34	
Valona	82	18	56.8	2.14	
Washington	75	19	48.6	1.12	
Waverly	85	17	57.5	2.43	
Waycross	82	21	57.2	1.41	
Waynesboro	79	20	51.4	0.70	
Westpoint	79	19	50.1	1.22	

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Georgia—Cont'd.	°	°	°	*Ins.*	*Ins.*
Woodbury	77	16	48.7	0.62	
Idaho.					
Albion	68	0	38.4	1.95	13.0
American Falls	68	5	35.6	1.22	......
Blackfoot	65	5	32.8	0.47	4.0
Blue Lakes	79	14	43.0	2.08	8.0
Burnside	60	−5	31.4	0.70	7.6
Cambridge	57	4	34.1	4.37	10.2
Chesterfield	65[d]	−5	31.2[d]	0.68	5.0
Forney	70	−11	32.3	2.53	17.2
Garnet	79	18	44.6	1.06	......
Grangeville	70	11	38.4	4.63	22.0
Lake	64	−8	37.6	0.90	9.0
Lakeview	59	10	35.6	3.93	20.5
Lost River	61	0	30.9	0.97	8.0
Meadows	61	−2	31.4	4.19	19.2
Moscow	64	12	37.5	2.79	13.6
Murray	60	−2	32.8	7.19	40.0
Oakley	70	6	40.3	1.40	11.5
Ola	64	6	37.8	4.36	8.2
Orofino	64	18	38.0	6.45	11.0
Payette	77	13	41.8	2.49	3.0
Pollock	66	23	42.6	2.25	4.4
Porthill	57	−2	32.3	3.09	8.0
Priest River	58	−1	32.8	5.40	20.0
Riddle	57[a]	26[a]	40.2[a]	3.17	21.0
St. Maries	72	15	37.5	4.30	10.7
Soldier	65	−18	27.6	3.32	28.0
Vernon[c]	64	−1	31.7	......	......
Weston	67	−3	33.4	2.56	23.0
Illinois.					
Albion	75	11	40.2	1.41	2.7
Aledo	72	7	36.1	0.98	0.2
Alexander	71	9	39.0	0.78	1.0
Antioch	69	3	33.3	0.70	2.0
Ashton	68	6	34.0	0.62	1.0
Astoria	70	10	37.0	1.27	2.5
Aurora	68	5	35.4	0.54	2.5
Benton	74	13	42.6	0.98	0.2
Bloomington	72	9	38.4	1.47	0.7
Bushnell	71	10	38.0	1.37	......
Cambridge	68	8	34.6	1.09	T.
Carlinville	74	8	39.7	0.54	2.0
Carrollton	70	9	39.5	0.28	2.5
Centralia	85[c]	13[c]	40.6[c]	0.47	1.2
Charleston	68	9	39.8	1.47	0.2
Chester	......	......	......	1.07	T.
Chicago Heights	......	......	......	0.68	3.0
Ciane	76	11	41.0	0.81	1.0
Coatsburg	70	7	36.6	0.88	T.
Cobden	77	14	43.5	2.22	1.0
Decatur	69	9	38.8	1.74	1.5
Dixon	69	11[b]	36.1[f]	0.73	0.1
Equality	77	12	42.4	1.29	2.0
Fandon	69	11	38.6	1.41	2.4
Flora	73	9	39.4	0.83	1.4
Friendgrove	72	13	41.0	1.73	1.5
Galva	70	8	35.5	1.08	0.5
Grafton	......	......	......	0.53	2.5
Greenville	78	11	39.8	1.10	3.0
Griggsville	69	11	39.3	0.68	0.2
Halfway	72	14	43.0	0.96	0.8
Havana	76	11	38.1	0.89	0.5
Henry	71	9	37.2	1.69	2.0
Hillsboro	74	8	39.8	0.61	0.8
Hoopeston	70	7	35.6	1.80	6.0
Joliet	69	10	36.0	0.86	1.9
Kishwaukee	72	5[c]	32.6[c]	1.25	4.0
Knoxville	71	6	35.6	1.08	0.8
Lagrange	69	8	35.2	0.37	2.0
Laharpe	70	10	37.2	1.02	1.5
Lanark	67	2	32.9	1.06	T.
La Salle	75	19	41.4	0.65	2.5
Loami	......	......	......	1.08	0.5
McLeansboro	74	14	42.0	0.98	1.5
Martinsville	69[f]	10[c]	37.1[f]	1.55	2.5
Martinton	75	5	36.0	0.79	1.0
Mascoutah	72	11	40.4	1.58	1.8
Mattoon	70	12	40.1	1.06	0.7
Minonk	73	8	36.9	0.92	3.0
Monmouth	72	6	35.6	0.72	0.2
Morrison	68	6	35.3	1.05	1.0
Morrisonville	72	10	39.2	0.55	0.2
Mount Carmel	......	......	......	1.89	4.1
Mount Pulaski	71	11	38.5	1.19	1.4
Mount Vernon	74	14	40.8	0.84	2.0
New Burnside	79	11	44.3	1.06	2.5
Olney	72	11	40.4	1.35	0.9
Ottawa	71	11	38.0	0.46	2.0
Palestine	75[c]	11[d]	43.1[d]	1.95	T.
Pana	70	11	39.2	0.42	T.
Paris	69[d]	12[c]	41.4[d]	0.56	......
Peoria *a*	......	......	......	0.71	T.
Peoria *b*	71	14	39.5	0.85	T.
Philo	69	7	37.1	2.04	T.
Plumhill	73	13	42.0	1.41	1.2
Pontiac	70	11	37.8	1.06	2.0
Rantoul	70	7	37.4	1.34	1.2

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Illinois—Cont'd.	°	°	°	*Ins.*	*Ins.*
Raum	76	13	42.8	1.81	2.0
Riley	68	6	34.2	0.82	2.1
Robinson	71	10	39.8	1.39	T.
Rushville	69	11	38.0	0.97	T.
St. Charles	70	6	34.5	1.06	3.0
St. John	75	12	41.9	1.12	1.0
Shobonier	77	8	41.5	0.87	2.0
Streator	73	8	37.2	0.78	0.2
Sullivan	74	10	38.9	1.97	1.4
Sycamore	71	5	33.6	0.97	2.5
Tilden	75	13	41.7	2.05	2.0
Tiskilwa	69	8	35.3	1.27	0.2
Tuscola	70	8	37.7	0.90	0.7
Urbana	68	8	36.1	2.06	1.5
Walnut	70	9	36.4	0.53	0.2
Winchester	72	13	38.4	0.58	1.5
Winnebago	70	6	34.2	1.15	3.0
Yorkville	69	6	34.3	0.36	1.0
Zion	69	5	34.0	1.13	T.
Indiana.					
Anderson	72	8	37.8	1.39	2.8
Angola	67	10	35.6	1.93	4.6
Auburn	71	5	35.2	0.93	......
Bloomington	71	15	38.5	2.11	T.
Bluffton	74	6	37.0	1.64	3.0
Butlerville	76	5	39.6	2.06	3.6
Cambridge City	71	6	35.3	1.97	2.5
Columbus	76	6	37.6	1.93	2.0
Connersville	74	6	37.3	1.68	2.0
Crawfordsville	74	8	36.8	1.58	2.0
Delphi	77	10	36.0	1.35	3.5
Elkhart	70	12	36.9	1.85	8.0
Farmersburg	78	10	38.0	1.66	1.3
Farmland	73	9	38.4	1.26	3.0
Fort Wayne	69	9	36.2	1.45	4.3
Franklin*1	74	13	38.1	1.89	4.0
Greencastle	68	10	37.6	0.87	1.8
Greenfield	74	10	37.4	2.95	2.5
Greensburg	76	6	38.4	2.99	5.0
Hector	70	5	34.6	1.25	4.0
Holland	79	12	43.2	1.19	1.7
Huntington	72	11	37.2	3.53	7.0
Jeffersonville	71	15	41.6	2.40	0.8
Kokomo	75	11	37.4	2.45	3.0
Lafayette	73	10	36.2	2.34	3.3
Laporte	69	13	37.2	1.64	10.1
Logansport	74	12	36.6	1.67	1.8
Madison *a*	74	13	40.6	2.02	0.4
Madison *b*	......	......	......	2.49	
Marengo	75	11	43.2	1.69	0.4
Marion	75	9	37.4	3.06	2.5
Markle	73	6	36.4	1.65	3.5
Mauzy	75	5	36.4	2.31	3.0
Moores Hill	73	6	38.8	1.61	3.8
Mount Vernon	77	13	41.8	0.51	2.5
Northfield	74	5	35.8	2.16	2.0
Paoli	74	7	40.3	1.05	1.0
Princeton	75	12	42.5	1.96	0.4
Rensselaer	70	9	37.7	1.13	4.0
Richmond	74	5	36.6	1.95	1.5
Rockville	70	8	38.0	1.44	T.
Rome	76	8	41.0	2.04	2.1
Salem	76	8	41.5	2.23	2.0
Scottsburg	72	11	41.6	1.87	0.8
Seymour	70	10	40.8	1.85	2.0
Shelbyville	76[d]	7[c]	40.6[d]	2.39	7.0
South Bend	74	8	35.8	1.43	8.5
Syracuse	72	11	36.9	1.86	6.0
Terre Haute	69	14	41.6	1.15	T.
Topeka	70	10	36.2	2.32	2.0
Valparaiso	71	2	37.4	1.68	......
Veedersburg	73[c]	7[c]	36.8[c]	1.79	T.
Vevay	72	10	41.6	2.15	3.0
Vincennes	74	12	40.4	2.29	0.8
Washington	73	12	40.2	2.48	......
Winamac	79[d]	10[c]	39.4[c]	1.05	2.2
Indian Territory.					
Ardmore	82	16	49.0	0.12	
Chickasha	85	8	47.1	0.00	
Claremore	......	......	......	0.37	
Durant	80[c]	16	50.0	0.18	
Fairland	75	13	44.8	0.83	T.
Goodwater	83	11	48.8	T.	
Hartshorne	80	16	49.9	0.35	
Healdton	86	8	50.1	0.00	
Holdenville	80	13	48.5	0.68	
Marlow	86	9	47.1	T.	
Muskogee	75	13	45.8	0.82	
Okmulgee	79[d]	12[d]	47.6[d]	0.82	
Pauls Valley	84	11	48.2	0.45	
Ravia	87	16	50.9	0.03	
Roff	80	11	48.6	0.10	
South McAlester	82	15	52.2	0.03	
Tahlequah	......	......	......	0.20	
Tulsa	......	......	......	1.36	
Wagoner	78	13	46.6	0.90	
Webbers Falls	79	14	46.7	1.21	

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Iowa.	°	°	°	*Ins.*	*Ins.*
Afton	67	4	36.3	0.88	4.0
Albia	70	8	36.2	0.64	T.
Algona	70	4	33.8	T.	......
Allerton	70	3	36.1	1.74	2.0
Alta	68	2	32.2	0.62	1.0
Amana	66	5	34.5	0.60	T.
Ames	68	5	35.2	0.14	
Atlantic	67	4	36.4	1.24	6.0
Audubon	66	−5	34.5	0.94	2.2
Baxter	70	2	34.2	0.20	......
Bedford	67	5	36.9	0.87	1.2
Belknap	75	9	41.0	1.51	......
Bonaparte	68	8	35.6	0.94	0.5
Britt	68	0	31.4	0.05	T.
Buckingham	......	......	......	0.29	T.
Burlington	72	9	37.2	0.84	T.
Carroll	73	−5	34.4	0.44	3.0
Cedar Rapids	67	7	33.8	0.48	......
Chariton	69	4	36.0	0.11	0.1
Charles City	69	0	30.5	T.	T.
Clarinda	70	7	37.5	1.13	0.8
Clearlake	68	−2	30.4	T.	T.
Clinton	67	8	35.0	0.78	0.3
College Springs	64	8	37.6	0.34	0.3
Columbus Junction	70	7	36.1	0.74	0.2
Corning	65	−1	35.9	0.85	3.5
Corydon	68	2	36.2	1.26	1.8
Council Bluffs	......	8	......	0.92	......
Cumberland	......	......	......	0.78	7.0
Decorah	68	3	32.2	0.18	......
Delaware	67	1	31.5	0.36	0.5
Denison	67	−1	35.1	0.46	1.0
Desoto	67	3	35.4	1.04	1.0
Dows	68	−1	32.4	0.10	T.
Earlham	68	−3	33.6	0.76	1.2
Elkader	72	2	32.4	0.21	T.
Estherville	69	0	30.0	0.06	......
Fayette	69	−1	31.0	0.06	T.
Forest City	73	0	31.0	T.	T.
Fort Dodge	68	5	33.0	0.41	......
Fort Madison	......	......	......	1.34	......
Galva	69	−3	31.6	0.05	0.5
Gilman	......	......	......	0.18	T.
Glenwood	67	7	37.2	0.35	1.0
Grand Meadow	68	2	31.2	0.28	0.5
Greenfield	68	1	35.8	0.65	2.8
Grinnell	64	3	33.9	0.24	T.
Grinnell (near)	66	2	33.4	0.25	T.
Grundy Center	68	0	33.3	0.21	T.
Guthrie Center	......	......	......	1.32	1.2
Hampton	72	2	33.3	0.19	T.
Hanlontown	68	−1	31.2	0.08	0.4
Harlan	66	1	35.0	1.62	7.2
Hopeville	69	1	35.2	0.78	......
Humboldt	69	2	34.6	0.08	......
Independence	69	1	32.1	0.16	T.
Indianola	69	3	35.9	0.73	1.2
Iowa City	72	6	34.2	0.97	......
Iowa Falls	68	0	31.0	0.09	T.
Jefferson	......	......	......	0.23	0.8
Keosauqua	68	9	34.5	0.74	0.3
Lacona	......	......	......	0.94	1.0
Larchwood	70[c]	1[d]	31.1[d]	0.17	1.6
Larrabee	69	−1	32.4	0.26	1.8
Leclaire	......	......	......	0.70	T.
Lemars	68	3	33.4	......	0.3
Lenox	66	2	35.9	0.43	1.7
Logan	65	6	35.5	1.54	5.8
Maple Valley	......	......	......	0.79	1.5
Maquoketa	68	4	32.8	1.13	......
Marshalltown	70	3	33.1	0.40	T.
Mason City	68	4	33.4	T.	......
Mountayr	67	6	37.1	0.63	2.0
Mount Pleasant	70	6	35.8	0.99	T.
Mount Vernon	67	2	32.6	0.93	0.4
New Hampton	70	−2	30.4	0.05	0.5
Newton	67	2	34.6	0.16	T.
Northwood	69	2	31.8	T.	T.
Odebolt	70	0	33.7	0.36	1.8
Ogden	69	−1	33.3	0.25	1.0
Olin	66	4	33.8	1.01	T.
Onawa	69	7	36.6	1.34	5.7
Osage	66	0	31.2	0.06	0.6
Osceola	69	5	39.0	0.56	2.0
Oskaloosa	70	4	35.3	0.57	T.
Ottumwa	74	10	37.7	0.65	T.
Pacific Junction	76	8	37.4	0.19	0.9
Perry	69	4	35.6	0.36	1.0
Plover	69	3	32.2	0.04	T.
Primghar	66	1	33.5	......	......
Redoak	65	10	39.0	0.36	2.0
Ridgeway	73	1	34.6	0.11	
Rockwell City	66	1	33.6	0.50	0.5
Ruthven	70	−4	32.6	T.	T.
Sac City	68	3	34.3	0.26	1.0
St. Charles	68	4	36.9	0.63	2.1
Sibley	66	1	25.8	0.02	0.2
Sioux Center	67	2	31.8	0.10	1.0

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Iowa—Cont'd.	°	°	°	*Ins.*	*Ins.*
Stockport	......	......	......	0.85	T.
Storm Lake	68	0	31.8	0.52	0.1
Stuart	65	6	34.0	0.84	1.5
Thurman	62	7	37.3	1.05	0.2
Tipton	70	8	35.4	1.53	......
Toledo	70	1	33.8	0.27	T.
Villisca	62	7	34.5	0.99	3.0
Vinton *1	69	3	33.4	0.20	T.
Wapello	68	9	37.0	0.79	0.8
Washington	70	3	34.2	1.46	T.
Washta	......	......	......	0.70	1.5
Waterloo	70	2	34.0	0.19	T.
Waukee	......	......	......	0.98	0.5
Waverly	69	2	32.8	0.08	T.
Westbend	69	1	33.9	0.03	T.
Wilton Junction	69	5	34.6	1.67	T.
Winterset [f]	66	1	35.4	......	1.0
Woodburn	......	......	......	1.04	1.5
Kansas.					
Achilles	78	−2	39.3	0.75	T.
Alton	68	5	41.2	1.27	
Anthony	......	......	......	0.32	
Atchison	69	12	41.0	1.58	1.2
Baker	65	9	38.2	1.42	
Beloit	69	8	39.4	0.77	T.
Burlington	79	12	42.9	1.13	0.5
Chanute [h]	74	12	43.0	0.74	
Clay Center	67	10	41.4	1.20	1.5
Colby	80	−5	40.0	0.97	0.5
Columbus	73	12	42.9	0.58	0.5
Cunningham	75[e]	7[e]	43.2[e]	1.00	
Dresden	73	2	40.9	0.91	T.
Eldorado	76	11	43.2	1.11	
Ellinwood	69	7	42.2	0.87	T.
Emporia	75	10	39.8	0.91	4.0
Englewood	80	8	44.6	1.05	T.
Enterprise	76	10	42.8	0.30	3.0
Eureka	......	......	......	0.30	T.
Eureka Ranch	71	0	40.4	0.94	T.
Fall River	79	12	42.8	1.57	T.
Farnsworth	72	−2	40.8	0.47	0.2
Fort Leavenworth	67	12	41.8	0.95	0.5
Fort Scott	74	12	43.2	1.13	0.1
Frankfort	69	9	39.7	1.15	1,5
Fredonia	77	10	41.8	0.92	T.
Garden City	80	−2	43.6	0.40	1.0
Gove *1	71	4	39.8	0.72	2.0
Grenola	79	11	42.6	1.00	0.0
Hanover	65	......	......	2.00	2.0
Harrison	65	7	39.0	1.10	0.5
Hays	70	4	39.6	0.88	
Holton	71	9	39.8	1.40	2.0
Horton	68	10	39.7	1.15	1.0
Hoxie	72	1	40.4	0.93	
Hutchinson	76	6	41.4	0.68	T.
Independence	76	12	43.7	1.27	
Jetmore	......	2	......	0.60	T.
La Crosse	72	4	40.8	1.29	T.
Lakin	79	4	42.0	0.36	0.5
Lawrence	73	12	41.4	1.74	3.0
Lebanon	65[f]	5[f]	41.4[f]	1.00	......
Lebo	76	11	40.9	0.81	1.0
Macksville	76	8	42.6	0.45	
McPherson	68	10	41.6	1.24	
Madison	77	11	41.6	1.71	1.0
Manhattan *b*	70	12	42.4	1.51	2.0
Manhattan *c*	72	12	41.0	1.47	3.0
Marion	67	11	42.9	2.10	T.
Medicine Lodge	80	12	43.9	0.88	
Minneapolis	65	9	40.6	0.66	0.5
Moran	75	10	42.8	0.97	1.0
Mounthope	70	15	44.4	0.76	
Newton	72	10	42.8	0.79	T.
Norton	74	3	40.0	0.25	
Norwich	75	10	43.0	0.60	
Oberlin	......	......	......	0.75	
Olathe	74	10	42.4	0.65	T.
Osborne	......	......	......	1.08	
Oswego	75	12	43.8	0.78	T.
Ottawa	76	9	41.0	0.91	1.5
Paola [1]	72	12	41.4	1.05	0.8
Pleasanton	73	13	42.9	2.28	
Pratt	77	8	44.6	T.	
Republic	65	7	39.2	1.25	0.5
Rome	80	11	44.4	0.47	
Salina	66	10	41.8	0.85	T.
Sedan	78	12	43.8	0.59	
Toronto	80	9	42.4	0.72	0.5
Ulysses	84[e]	−1[e]	42.2[e]	0.31	1.0
Valley Falls	73	8	40.6	1.12	1.0
Viroqua	85	−1	42.8	0.20	1.0
Wakeeney	......	......	......	0.51	T.
Wallace	83	−4	41.4	0.78	0.5
Walnut	75	11	43.4	0.81	T.
Wamego *1	70	12	40.3	1.81	3.0
Winfield	78	13	43.1	1.66	
Kentucky.					
Alpha	77	12	44.2	3.90	1.0
Kentucky—Cont'd.					
Anchorage	74	8	40.4	2.71	1.2
Bardstown	80	10	43.0	3.33	2.1
Beattyville	76[e]	6[e]	38.1[e]	2.58	3.0
Beaver Dam	77	10	43.0	3.55	1.2
Berea	76	6	42.4	4.04	1.3
Blandville	73	15	43.0	2.12	1.8
Bowling Green	77	13	44.6	1.21	1.2
Burnside	76	11	43.2	3.59	1.0
Cadiz	75	14	43.8	4.20	2.0
Calhoun	75[i]	12[d]	41.8[d]	3.27	1.2
Catlettsburg	76	11	42.2	2.60	3.5
Earlington	76	13	44.7	3.89	1.8
Edmonton	76	9	42.7	3.89	3.0
Eubank	75[e]	7[b]	40.6[b]	3.47	2.0
Falmouth	......	......	......	2.04	2.2
Frankfort	72	10	41.9	3.14	3.0
Franklin	70	16	44.9	3.35	1.5
Greensburg	76	8	39.4	3.39	0.5
Highbridge	74	13	42.7	3.94	3.5
Hopkinsville	76	13	44.2	4.53	2.0
Irvington	72	15	42.8	2.62	T.
Jackson	78	9	45.0	2.45	4.5
Leitchfield	74	10	42.8	2.97	1.5
Mayfield	73	17	44.8	3.32	1.6
Maysville	81	9	41.0	2.10	5.9
Middlesboro	78	7	40.5	2.32	
Mount Sterling	77	10	39.8	3.73	5.0
Nerinx	75	5	41.8	3.10	T.
Owensboro	76	14	43.5	1.90	1.0
Owenton	71	11	40.3	2.76	3.0
Paducah *a*	......	......	......	1.98	2.0
Paducah *b*	77	18	45.8	2.26	2.0
Princeton	76	15	45.3	3.96	2.5
St. John	73	10	43.0	4.45	1.0
Scott	78	7	40.0	1.90	2.4
Shelby City	73	7	41.0	3.89	1.5
Shelbyville	72	10	40.0	3.20	3.0
Taylorsville	73	8	41.0	2.84	0.2
Williamsburg	78	10	41.8	3.07	2.2
Williamstown	76	8	41.8	1.95	1.0
Louisiana.					
Abbeville	86	22	57.9	0.92	
Alexandria	87	19	53.6	0.46	
Amite	86	22	56.0	0.35	
Baton Rouge	87	23	57.9	1.35	
Burnside	86	22	57.6	0.86	
Cameron	84	28	58.7	0.02	
Caspiana	86	13	54.3	0.23	
Cheneyville	87	18	52.7	0.00	
Clinton	84	23	55.9	0.55	
Collinston	87	10	50.0	0.04	
Covington	87	24	57.1	0.62	
Donaldsonville	88	25	60.2	0.65	
Emilie	82	25	57.0	T.	
Franklin	87	28	59.2	0.40	
Grand Coteau	85	22	57.3	0.77	
Hammond	84	24	56.6	1.35	
Houma	84	25	57.8	0.16	
Jennings	86	23	55.0	0.44	
Lafayette	85	22	57.0	0.55	
Lake Charles	......	......	......	0.40	
Lake Providence	86	18	54.6	0.09	
Lakeside	85	25	57.8	0.23	
Lawrence	86	30	60.4	0.80	
Leesville	84	15	54.8	3.26	
Libertyhill	87	15	54.2	0.18	
Logansport	......	......	......	0.34	
Melville	87	21	57.0	0.34	
Minden	94	20	51.5	0.00	
Monroe	85	20	53.1	0.16	
New Iberia	84	24	59.1	0.45	
Opelousas	87	18	55.8	0.47	
Oxford	86	13	55.1	0.00	
Plain Dealing	84	11	50.8	0.05	
Port Eads	81	39	64.0	0.73	
Rayne	86	18	55.2	0.39	
Reserve	82	28	56.3	0.12	
Ruston	85	12	52.4	T.	
Schriever	89	24[e]	59.1[e]	0.07	
Southern University	......	......	......	0.14	
Sugar Experiment Station	82	28	59.0	0.23	
Sugartown	83[d]	27[d]	56.4[d]	......	
Venice	86	33	61.4	1.05	
Wallace	88	26	58.6	T.	
Maine.					
Bar Harbor	67	10	35.8	3.97	17.5
Belfast	67	5	34.5	2.46	15.5
Cornish	69	4	34.0	1.63	4.5
Danforth	......	......	......	3.59	0.2
Fairfield	71	1	33.8	1.06	1.0
Farmington	73	−5	32.1	1.24	5.0
Fort Fairfield	62[e]	−5[e]	27.2[e]	1.65	11.0
Gardiner	72	4	33.6	1.63	2.8
Houlton	60	5	32.0	2.62	26 0
Lewiston	75	8	35.1	1.58	4.0
Mattawamkeag	......	......	......	2.50	16.0
Mayfield	64	4	31.0	1.61	7.0
Millinocket	......	......	......	2.64	13.0
Maine—Cont'd.					
North Bridgton	74	5	35.2	1.02	1.0
Orono	70	2	33.8	2.79	15.5
Patten	67	−5	30.0	2.42	......
Rumford Falls	70	4	32.8	0.98	2.0
South Lagrange	68	−2	31.6	1.85	11.0
The Forks	......	......	......	1.73	9.5
Vanburen	65	−8	28.8	2.05	11.0
Vanceboro	67	0	30.8	5.08	24.0
Winslow	70	−1	33.1	1.34	4.5
Maryland.					
Annapolis	74	17	45.0	1.12	0.2
Bachmans Valley	68	13	36.4	1.53	T.
Boettcherville	82	15	39.3	0.88	1.0
Boonsboro	74	15	40.5	1.06	0 5
Cambridge	74	18	43.6	1.83	0.2
Charlotte Hall	77	16	43.0	1.36	1.0
Chase	74	11	40.6	0.91	0.5
Cheltenham	73	15	41.2	1.09	0.5
Chestertown	68	17	41.1	1.17	0.2
Chewsville	74	8[d]	35.7[b]	1.19	0.6
Clearspring	72	14	39.4	1.41	1.0
Coleman	74	18	43.8	0.79	T.
Collegepark	78	12	42.8	......	......
Colora	......	......	......	1.10	T.
Cumberland	......	......	......	0.88	1.0
Darlington	74	13	41.0	0.93	T.
Deerpark	72	1	32.8	2.60	7.0
Easton	74	15	42.7	1.04	T.
Fallston	74	14	41.2	0.92	0.5
Frederick	75	16	41.2	0.72	1.0
Grantsville	69	2	33.4	2.16	3.5
Greatfalls	......	13	37.0[d]	0.56	......
Greenspring Furnace	72	13	38.8	1.15	0.8
Hancock	77	13	39.4	0.91	0.2
Harney	......	......	......	0.94	0.5
Jewell	73	16	42.6	0.98	T.
Johns Hopkins Hospital	74	18	44.4	0.95	1.5
Laurel	75	11	40.2	0.98	0.5
McDonogh	74	14	41.2	......	......
Mount St. Marys College	73	16	41.7	0.71	0.8
New Market	71	14	40.5	0.85	0.5
Oakland	73	1	33.7	2.15	2.0
Pocomoke City	76	20	51.0	1.52	1.0
Princess Anne	75	17	42.8	2.21	0.4
Sharpsburg	72	16	41.5	0.85	0.5
Solomons	71	20	44.6	1.57	1.0
Sudlersville	75	16	42.2	1.27	......
Takoma Park	73	14	40.7	0.86	0.5
Van Bibber	71	17	41.6	1.20	T.
Westernport	73	14	37.7	1.29	0.8
Woodstock	71	17	42.0	0.64	0.2
Massachusetts.					
Amherst	74	6	35.1	2.04	T.
Bedford	70	9	36.5	1.48	T.
Bluehill (summit)	71	9	36.8	1.20	4.0
Cambridge	73	12	38.4	1.52	......
Chestnuthill	71	9	39.0	1.53	T.
Cohasset	......	......	......	2.05	1.0
Concord	74	6	35.4	1.61	0.7
East Templeton *1	65	6	32.6	1.67	1.0
Fall River	69	14	39.4	2.01	8.0
Fitchburg *a* *1	68	7	34.6	2.00	0.2
Fitchburg *b*	72	8	36.1	2.13	T.
Framingham	72	9	38.0	1.48	1.0
Groton	70	6	35.1	2.09	T.
Holyoke	......	......	......	2.25	T.
Hyannis	......	......	......	6.11	14.2
Jefferson	......	......	......	2.52	1.8
Lawrence	73	9	36.7	1.33	1.0
Leominster	......	......	......	2.20	0.5
Lowell *a*	74	9	38.2	1.53	......
Lowell *b*	74	6	37.4	......	......
Ludlow Center	......	......	......	2.86	......
Middleboro	74	3	36.6	1.67	3.2
Monson	67	4	34.4	2.76	0.7
New Bedford	71	13	39.5	3.57	8.5
Pittsfield	......	......	......	2.32	......
Plymouth	......	......	......	3.23	0.4
Princeton	......	......	......	2.60	3.0
Provincetown	72	20	43.7	4.39	7.0
Somerset *1	72	7	38.4	2.39	5.5
Sterling	......	......	......	2.16	T.
Taunton	74	4	36.2	1.68	3.1
Webster	......	......	......	2.10	1.0
Westboro	73	7	37.8	1.70	0.5
Weston	70	7	35.8	1.51	1.7
Williamstown	62	7	33.4	1.92	T.
Winchendon	......	......	......	2.03	1.5
Worcester	70	11	37.2	1.89	0.5
Michigan.					
Adrian	74	8	35.2	1.40	T.
Agricultural College	71	6	34.0	1.45	2.0
Allegan	72[d]	4[e]	34.2[d]	1.79	14.0
Alma	70	7	33.8	0.80	2.5
Ann Arbor	73	10	35.0	1.58	2.5
Annpere	62	......	......	0.75	2.0
Arbela	73	11	35.2	1.95	4.0
Baldwin	70	8	32.8	1.55	1.5

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.)			Precipitation.	
	Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.
	°	°	°	Ins.	Ins.
***Michigan*—Cont'd.**					
Ball Mountain	70	8	33.6	1.75	1.7
Baraga	76	8	30.4	......	......
Battlecreek	70	6	33.7	1.95	8.0
Bay City	70	12	33.6	1.95	3.5
Benzonia	61[h]	11[g]	31.3[h]	3.06	13.5
Berlin	72	11	34.8	1.42	3.0
Big Rapids	69	0	31.2	2.14	4.0
Birmingham	71	10	34.8	1.49	3.6
Calumet	64	9	29.8	4.19	38.0
Cassopolis	71	8	34.8	2.20	10.0
Charlevoix	......	......	......	1.70	3.0
Chatham	78	1	31.3	3.29	32.5
Cheboygan	73	6	33.1	0.70	7.0
Clinton	76	8	35.2	1.28	1.5
Coldwater	74	9	36.1	1.90	5.0
Deerpark	60	7	31.6	2.70	......
Detour	64	4	33.0	2.89	14.0
Dundee	70	8	35.6	1.63	1.6
East Tawas[c]	73	13	32.0	1.49	......
Eloise	77	8	35.4	1.02	2.2
Ewen	68	−3	26.8	1.35	13.5
Fennville[h]	68	4	32.6	1.99	15.5
Fitchburg	71	5	34.2	2.21	3.5
Flint	71	10	33.6	1.81	1.5
Frankfort	59[e]	......	......	1.05	4.0
Gaylord	63	13	32.5	2.50	23.0
Grand Haven	66	6	36.0	1.24	T.
Grand Marais	65	11	33.4	2.09	17.6
Grape	72	9	36.0	2.78	1.6
Grayling	70	−2	30.8	2.20	18.5
Hagar	71	7	37.2	1.24	9.5
Harbor Beach	70	6	32.6	2.27	7.0
Harrison	57[g]	2[e]	29.5[e]	2.15	......
Harrisville	74	10	33.0	1.66	4.9
Hart	......	......	......	0.75	5.0
Hastings	72	3	34.6	1.57	5.7
Hayes	65	10	34.8	1.45	4.0
Highland Station	......	......	......	1.71	5.9
Hillsdale	71	8	33.9	1.58	1.5
Humboldt	70	−10	25.4	1.60	16.0
Ionia[i]	70	6	35.0	......	......
Iron Mountain	72	4	27.7	2.56	17.0
Iron River	70[f]	−10[f]	22.6[f]	1.40	14.0
Ironwood	69	0	27.4	2.09	19.6
Ishpeming	70	−5	26.7	3.60	30.2
Ivan	67	10	31.5	2.46	19.0
Jackson	75	8	35.6	1.43	5.5
Jeddo	69	10	34.3	2.95	13.2
Kalamazoo	71	9	35.6	2.78	17.4
Lake City	51	0	29.2	0.55	5.0
Lansing	70	7	34.2	1.45	2.0
Lapeer	70	10	34.7	1.84	......
Ludington	62	17	35.0	......	......
Mackinac Island[d]	59	5	32.8	2.75	5.8
Mackinaw	65	7	33.2	1.80	7.0
Mancelona	62	4	31.2	1.20	12.0
Manistee	60	17	35.3	......	......
Manistique	62	4	31.2	2.09	12.5
Menominee	72	2	30.7	1.42	5.5
Mio	70	3	29.8	1.94	10.2
Montague	62	0	34.4	1.78	7.0
Mount Pleasant	70	8[d]	35.2	1.22	......
Muskegon	70	9	36.6	1.72	6.0
Newberry	70[h]	2	30.4[i]	1.20	12.0
Old Mission	68	10	33.7	3.04	12.0
Olivet	67	7	34.9	1.92	3.0
Omer	72	1	29.4	1.75	6.0
Onaway	68	5	31.7	0.47	T.
Ovid	68	7	34.7	1.11	1.0
Owosso	73	8	35.0	1.10	T.
Petoskey	64	5	32.2	1.91	7.4
Port Austin	69	5	32.9	1.69	3.5
Reed City	68[e]	8[d]	32.8[d]	......	......
Roscommon	77	......	......	1.75	9.5
Saginaw (W. S.)	71	8	35.6	1.32	1.8
St. Ignace	62	2	33.4	1.59	6.0
St. Johns	70[e]	8[e]	37.2[d]	......	......
St. Joseph	61	10	36.5	1.10	11.0
Slocum	......	8	......	......	3.0
Somerset[i]	71	6	32.4	......	......
South Haven	74	4	37.6	1.18	4.0
Thomaston	68	−6	26.8	1.80	18.0
Thornville	69	16	35.2	2.09	5.0
Traverse City	69	10	34.7	3.62	25.0
Vassar	70	11	36.2	1.55	2.7
Wasepi	70	8	34.8	1.60	5.5
Webberville	73	3	34.5	1.99	4.9
West Branch[h]	68	5	28.2	0.92	9.1
Wetmore	......	......	......	3.17	31.7
Whitefish Point	68	9	32.2	3.77	24.5
Ypsilanti	66	6	33.9	1.49	3.8
Minnesota.					
Ada	70	−15	22.2	0.22	2.2
Albert Lea	68	−1	31.2	T.	T.
Alexandria	69	−7	25.6	0.03	0.3
Angus	72	−25	20.7	0.65	6.5
Ashby	68	−3	26.8	0.18	2.2
Beardsley	75	−4	28.9	0.10	0.5
***Minnesota*—Cont'd.**					
Beaulieu	69	−21	24.1	0.32	5.0
Bemidji	67	−18	25.2	0.18	1.8
Bird Island	68	0	28.6	0.34	2.0
Blooming Prairie	70	−3	29.3	T.	T.
Brainerd	69	−12	25.0	0.30	3.0
Caledonia	66	3	29.9	T.	T.
Collegeville	69	−1	29.6	0.08	0.6
Crookston	66	−15	22.0	0.82	8.2
Currie[c]	75	0	30.5	......	
Deephaven	......	......	......	0.34	0.2
Detroit	67	−18	22.6	0.30	3.0
Duluth (sub station)	69	−7	25.6	1.15	10.7
Faribault	71	−3	29.8	0.12	0.1
Farmington	67	−2	28.2	0.40	3.0
Fergus Falls	67	−5	26.2	0.21	2.1
Floodwood	69	−25	23.8	0.81	7.0
Glencoe	69	0	29.4	0.25	2.5
Grand Meadow	69	−2	29.7	T.	0.2
Hallock	72	−22	20.8	0.62	5.5
Lake Winnibigoshish	67	−21	23.3	0.95	9.7
Leech	72	−22	21.8	0.74	8.6
Long Prairie	68	−14	25.6	0.16	1.5
Luverne	65	4[e]	31.1[e]	0.08	......
Lynd	68	0	29.5	0.22	3.0
Mapleplain	68	−4	28.8	0.48	3.9
Milaca	70	−12	26.2	0.40	3.0
Milan	70	−4	28.0	0.30	2.5
Minneapolis[1]	68[e]	−2	28.8	0.22	1.9
Montevideo	68	0	29.2	0.22	2.5
Morris	70	−5	27.0	0.15	1.5
Mount Iron	68	−24	20.1	1.96	19.3
New London	73	0	28.6	0.23	2.3
New Richland	71	1	32.0	T.	T.
New Ulm	66	2	29.9	0.15	0.8
Park Rapids	67	−19	22.4	0.44	4.4
Pine River	68	−25	24.4	0.19	4.0
Pipestone	65	−1	29.4	0.04	0.6
Pleasant Mounds	71	1	32.4	0.04	T.
Pokegama Falls	70	−37	20.1	1.10	9.8
Redwing *a*	......	......	......	0.22	2.0
Redwing *b*	64	0	30.6	0.27	3.0
Reeds	......	......	......	0.10	2.3
Rolling Green	68	5	31.0	T.	T.
St. Charles	66	3	30.8	T.	T.
St. Peter	71[e]	0[e]	28.4[e]	0.10	T.
Sandy Lake Dam	70	−23	25.2	0.82	8.3
Shakopee	67	−2	30.4	0.30	2.0
Tower	37	−26	14.2	1.20	12.0
Two Harbors	68	−12	27.0	0.95	1.0
Wabasha	71	0	32.2	0.22	2.2
Winnebago	68	1	32.6	T.	T.
Winona	64	4	31.9	0.02	0.2
Wyoming	......	......	......	0.20	1.0
Zumbrota	68	−1	30.0	T.	T.
Mississippi.					
Aberdeen	79	16	47.0	2.49	
Agricultural College	80	18	51.0	0.15	
Austin	79	13	48.2	0.60	
Batesville	81	17	47.2	2.54	
Bay St. Louis	83	28	58.2	0.13	
Biloxi	81	27	59.2	4.07	
Boggan	81	11	52.4	0.18	
Booneville	76	16	47.2	0.86	
Brookhaven	83[g]	24[f]	55.6[g]	0.00	
Canton	85	15	52.2	0.65	
Columbus	77	20	49.4	5.51	
Corinth	78	16	45.0	2.64	
Crystal Springs	84	17	53.1	0.26	
Duck Hill	82	14	49.8	1.50	
Edwards	85	15	53.8	1.24	
Fayette	84	16	52.7	0.42	
Fayette (near)	......	......	......	0.52	
Greenville *a*	79	24	51.6	0.27	
Greenville *b*	83	19	50.5	0.28	
Greenwood	84	6	50.0	1.45	
Hattiesburg	86	21	53.8	1.07	
Hazlehurst	86	19	53.8	0.40	
Hernando	84	18	49.2	1.95	
Holly Springs	77	18	46.2	4.09	
Indianola	80	14	49.4	1.04	
Jackson	84	15	51.3	0.35	
Kosciusko	82	17	50.4	1.12	
Lake	83	15	50.3	1.33	
Lake Como	85	19	54.0	1.65	
Louisville	80	18	52.5	0.00	
McNeill	85	25	58.2	0.59	
Macon	80	19	49.8	2.24	
Magnolia	86	19	54.7	0.48	
Natchez	87	23	55.8	T.	
Nittayuma	86	11	50.8	0.14	
Okolona	85	17	48.8	2.20	
Patmos	......	......	......	0.08	
Pearlington	82	26	56.9	0.29	
Pittsboro	81	15	50.0	1.85	
Pontotoc	79	16	49.0	2.73	
Port Gibson	86	16	53.2	0.66	
Ripley	76	12	46.2	2.60	
Shoccoe	85	10	50.9	T.	
***Mississippi*—Cont'd.**					
Stonington	......	......	......	0.56	
Suffolk	87	17	54.4	0.39	
Swartwout	86	25	59.5	1.11	
Thornton	88	15	51.8	0.90	
Tupelo	82	11	48.6	3.18	
University	80	17	50.3	2.44	
Utica	86[d]	17[d]	55.8[d]	0.03	
Walnutgrove	82[e]	18[e]	52.6[e]	0.19	
Watervalley	82	16	48.4	2.16	
Waynesboro	82	20	52.6	1.31	
Westpoint	79	18	51.3	1.43	
Woodville	81	21	55.5	0.43	
Yazoo City	85	14	50.8	T.	
Missouri.					
Appleton City	79	11	43.0	0.73	1.0
Arthur	75	11	42.6	1.90	
Avalon	......	9	......	1.94	0.5
Bethany	68	9	37.8	0.67	1.0
Birchtree	73	12	43.2	0.54	0.5
Blue Springs	70[c]	10[b]	40.7[b]	1.38	0.2
Boonville	......	......	......	1.00	
Brunswick	70	11	39.5	1.71	1.0
Carrollton	68	11	40.6	1.43	T.
Caruthersville	78	15	46.6	3.26	
Conception	67	8	37.8	2.81	1.0
Darksville	69	9	40.2	0.50	1.0
Dean	74	5	44.1	0.93	
Desoto	71	10	41.8	1.38	1.0
Downing	......	......	......	1.24	2.0
Edgehill	75	12	41.6	1.56	0.5
Eightmile*[3]	......	18	43.2	1.33	T.
Fairport	......	......	......	1.08	0.5
Fayette	73	14	42.0	1.69	1.0
Fulton	77	10	41.8	0.59	0.5
Gallatin*[1]	70	14	40.2	1.35	0.2
Gano	75	10	38.3	0.73	T.
Glasgow	70	12	39.6	1.11	1.5
Gorin	......	......	......	2.34	2.3
Grant City	67	9	38.4	1.26	1.0
Halfway	77	11	43.6	0.21	T.
Harrisonville	70	12	39.8	1.77	T.
Hazlehurst	......	......	......	1.00	0.7
Hermann	......	......	......	0.48	0.1
Houston	74	9	42.7	0.55	T.
Huntsville	69	10	40.2	0.59	1.5
Ironton	76	9	42.0	1.48	0.5
Jackson	79	13	44.2	2.69	1.5
Jefferson City	75	11	40.7	0.56	0.5
Joplin	......	16	......	0.60	T.
Kidder	67	9	38.4	1.45	0.6
Koshkonong	74	12	44.2	1.40	0.2
Lamar	74	12	43.6	1.15	
Lamonte	......	......	......	1.31	T.
Lebanon	75	9	43.2	0.50	
Lexington	70	13	42.1	1.99	0.1
Liberty	70	11	40.7	1.28	0.2
Louisiana	73	5	39.0	1.09	3.0
Macon	71	8	38.8	0.46	2.5
Marblehill	78	11	43.5	1.77	1.5
Marshall	70	11	40.2	1.39	0.4
Maryville	65	9	36.4	2.09	0.5
Mexico	72	9	39.6	0.47	2.0
Miami*[5]	68	12	39.6	2.23	0.6
Mineral Springs	72	9	43.4	1.15	
Monroe City	73	2	37.0	0.62	2.2
Montreal	77	6	41.6	0.92	T.
Mountaingrove	72	10	42.2	0.95	0.5
Mount Vernon	74	9	43.0	1.54	
Neosho	73	9	43.8	1.03	T.
Nevada	......	......	......	1.68	T.
New Haven	74	13	42.8	0.67	2.0
New Madrid	......	......	......	3.10	
New Palestine	75	12	42.6	1.39	0.2
Oakfield	74	12	42.2	1.63	2.5
Olden	78	11	44.0	2.07	0.1
Oregon	66	10	38.5	1.21	1.2
Palmyra*[5]	72	8	38.1	1.74	6.5
Pine Hill	......	......	......	1.23	0.9
Princeton	67	5	36.7	1.27	3.5
Protem[4]	73	9	42.8	1.29	
Richmond	......	......	......	0.99	1.0
Rockport	......	......	......	1.50	1.0
Rolla	......	......	......	0.41	0.3
St. Charles	74[f]	11	40.0[e]	0.60	1.5
St. Joseph	......	......	......	1.30	T.
Sarcoxie	......	......	......	0.80	1.0
Sedalia	74	11	41.9	1.65	0.2
Seymour	75	9	41.8	1.33	T.
Shelbina	......	......	......	0.20	1.0
Sikeston	77	15	45.4	2.47	1.1
Steffenville	71[d]	8[d]	38.4[d]	1.38	2.9
Sublett	69	2	37.0	1.70	7.0
Trenton	68	11	38.5	0.97	0.5
Unionville	64	5	36.7	2.62	5.5
Vichy	74	7	41.6	0.73	0.5
Warrensburg	72	11	41.9	0.99	0.1
Warrenton	75	9	38.8	0.60	1.5
Wheatland	......	......	......	0.43	1.0

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Missouri—Cont'd.	°	°	°	*Ins.*	*Ins.*
Willowsprings	74	8	43.4	1.13	1.0
Zeitonia	75	9	42.0	1.46	0.5
Montana.					
Adel	66	−36	27.5	1.30	13.0
Augusta	72	−39	27.0	1.71	16.0
Boulder	64	−24	28.3	0.45	
Bozeman	62	−23	27.1	1.62	16.2
Butte	60	− 5	32.3	1.90	16.5
Canyon Ferry	69	−23	26.0	1.04	11.6
Chinook[e]	75	−28	25.6		
Columbia Falls	65	− 6	28.2	2.21	7.5
Crow Agency	70	−22	30.4	0.95	5.0
Culbertson	76	−15	25.9	0.12	0.2
Dayton	65	− 3	31.9	2.48	18.0
Deerlodge	64	−23	28.3	1.64	
Dillon	64	−18	31.4	1.52	13.7
Ekalaka	70	−12	29.2		
Fort Benton	72	−26	27.4	0.40	4.0
Fort Harrison	69	−23	24.8		
Glasgow	74	−27	24.6	0.44	
Glendive	75	−12	28.6	T.	T.
Greatfalls	70	−25	31.6	0.83	8.3
Hamilton	65	− 6	29.0	0.63	19.0
Kipp	68	−35	24.4	0.70	
Lamedeer	73	−20	32.6	0.35	2.5
Lewistown	75	−22	30.2	0.70	12.0
Livingston	68	−20	34.1	1.44	12.0
Marysville	62	−18	26.6	3.13	32.0
Missoula	65	− 5	30.3	1.34	
Ovando	63	−23	24.4	1.49	11.0
Philipsburg	71	−18	29.4	2.68	14.5
Plains	66	3	31.4	2.64	20.0
Poplar	75	−14	26.0	0.35	3.5
Redlodge	67	−18	30.8	0.87	20.0
Ridgelawn	70	−12	26.7	0.15	1.5
St. Pauls	74	−18	31.6	0.45	10.4
St. Peter	66	−18	30.2	0.92	18.0
Springbrook	74	−12	29.4	0.73	2.2
Toston	70	−26	27.6	2.66	18.0
Troy	63	− 4	30.6	4.86	19.0
Twin Bridges	64	−24	26.5	0.90	9.0
Utica	71	−20	32.0	0.44	5.0
Wolf Creek	64	−25	29.2	1.08	13.8
Wolsey	66	−35	24.5	1.39	18.5
Yale	69	−21	27.7	1.90	19.0
Nebraska.					
Agate	71	−13	33.8	0.18	1.0
Agee*[1]	74	− 2	31.7	0.77	4.5
Albion	64[d]	− 1[d]	35.3[d]	0.97	4.0
Alliance	65	− 5	33.6	0.05	0.5
Ansley	70	− 3	35.6	0.60	1.0
Arapahoe				0.80	
Arcadia				0.75	1.5
Ashland *a*	64	8	38.7	0.50	2.0
Ashland *b*				0.44	1.0
Ashton				1.07	2.0
Auburn	67	10	39.3	1.35	1.0
Aurora				1.30	3.0
Bartley	71	− 1	38.2	0.41	
Beatrice	65	8	38.6	1.67	2.0
Beaver	69	2	40.1	0.71	
Bellevue				0.47	1.3
Benedict				1.20	1.5
Benkleman				0.61	0.5
Blair	66	6	36.4	1.52	2.5
Bluehill				0.90	T.
Bradshaw				2.49	T.
Bridgeport	78	− 6	36.6	0.11	1.0
Brokenbow	69	1	37.8	0.40	T.
Burchard				2.04	
Burwell				0.20	T.
Callaway	67	− 5	35.7	0.55	T.
Central City				0.72	T.
Chester				1.97	
Columbus	63	6	37.2	0.90	T.
Crete	63	6	38.6	1.10	0.5
Culbertson	76	− 2	34.8	0.77	T.
Curtis	68[f]	− 2[e]	36.6[f]	0.40	
David City	63	4	37.6	1.52	0.8
Dawson	67	9	38.6	1.39	0.2
Edgar				2.74	3.0
Ericson				0.85	5.5
Ewing				0.85	3.0
Fairbury	66	6	38.3	1.38	2.5
Fairmont	62	5	36.8	0.90	2.0
Fort Robinson	75	− 9	35.1	0.10	1.0
Franklin	75[e]	0[e]	37.8[e]	1.13	
Fremont	67	7	36.9	1.46	1.5
Fullerton				1.10	3.5
Geneva	62	5	37.9	1.16	2.0
Genoa (near)	62	3	36.8	1.34	2.0
Gothenburg	74	− 1	38.4	0.60	T.
Grand Island *b*	66	5	38.6	1.29	2.5
Greeley				0.55	2.5
Guide Rock				1.23	1.0
Halsey	79	− 1	38.5	0.44	
Harvard	64	4	36.8	0.92	2.0
Hastings*[1]	64	4	37.2	1.12	3.0

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Nebraska—Cont'd.	°	°	°	*Ins.*	*Ins.*
Hayes Center				0.44	T.
Hay Spring	71	− 6	33.4	0.21	T.
Hebron	67	8	39.0	1.35	3.0
Hickman				1.60	
Holbrook				0.30	
Hooper*[1]	63	8	36.0	1.09	2.8
Imperial	76	− 5	38.8	0.59	0.5
Johnstown				0.55	0.2
Kearney	66	4	37.2	0.58	
Kennedy	78	− 5	35.8	T.	T.
Kimball	70	− 8	36.5	0.15	1.5
Kirkwood	76	0	35.2	0.35	2.5
Leavitt	70	6	38.4	1.36	0.5
Lexington	71	0	36.6	0.72	
Lockridge	63	5	37.5	1.47	2.8
Lodgepole	74	− 8	40.6[b]	T.	T.
Loup	65	1	38.4	1.21	1.0
Lynch	74	3	33.3	1.04	8.0
Lyons				1.61	0.6
McCook				1.40	T.
McCool Junction				1.43	
Madison	61	5	37.0	1.45	4.0
Madrid	78[d]	2[d]	37.5[d]	0.36	
Marquette				1.00	3.0
Mason				0.95	
Minden	65	3	37.9	0.91	0.2
Monroe				0.95	2.2
Nebraska City *c*	65	9	38.8	1.30	1.0
Nemaha				2.19	1.0
Norfolk	67	2	34.5	1.09	4.0
North Loup		4		0.85	1.2
Oakdale	63	3	34.3	0.66	2.9
O'Neill	75[f]	0	36.3[e]	1.52	6.5
Ord				0.35	
Palmer				0.85	4.0
Palmyra*[1]	64	6	37.0	1.00	T.
Pawnee City	75	10	40.6	1.84	1.0
Plattsmouth *b*	76[e]	10	39.8[b]	0.50	1.2
Purdum	75	− 1	36.2	0.80	
Ravenna *a*	68	3	37.7	0.74	1.5
Ravenna *b*				0.91	2.0
Redcloud	67	6	38.8	1.18	T.
Republican				0.80	
Rulo				1.78	0.5
St. Libory				1.37	4.0
St. Paul	66	− 4	38.8	1.01	1.5
Salem				1.27	0.2
Santee	66	3	35.2	0.89	6.5
Schuyler				0.92	0.5
Seward				1.60	0.5
Smithfield				0.56	
Spragg				0.65	3.0
Springview	78	0	35.0	0.05	0.5
Stanton	62	4	35.4	1.34	5.0
Strang				1.72	2.0
Stratton				0.91	
Stromsburg				0.41	
Superior	62	6	38.8	1.49	1.5
Syracuse				1.34	
Tablerock				1.69	1.0
Tecumseh *c*				1.62	1.5
Tekamah	67	7	38.2	1.83	5.5
Turlington	66	8	38.6	1.81	3.0
University Farm	65	8	38.9	1.80	0.5
Wahoo				1.30	T.
Wakefield	66	2	35.0	0.76	3.1
Wallace				0.40	2.0
Wauneta				0.40	
Weeping Water				1.73	1.0
Westpoint	65	5	36.6	1.03	3.0
Wilber				1.00	
Wilsonville				0.60	
Winnebago	66	0	37.1	0.72	2.0
Wisner				2.62	4.8
Wymore				1.43	2.0
York	62	7	39.4	1.10	2.0
Nevada.					
Austin	64	15	43.4	0.04	
Battle Mountain	80	13	44.0	0.90	
Belmont	59	10	39.8	0.00	
Beoware	73	18	42.4	1.05	T.
Candelaria	67	23	47.0	0.00	
Carlin				0.00	
Carson City	72	14	44.1	1.42	
Cranes Ranch				1.49	
Dyer	70	6	39.5	0.00	
Elko	63	5	38.6	2.05	
Ely	64	7	39.8	0.36	
Eureka	69	10	43.5	T.	T.
Fallon	70	11	43.8	0.80	
Glenbrook				2.38	
Golconda*[1]	70	23	44.9	1.10	
Hawthorne	75	20	46.4	T.	
Humboldt	68	11	42.4	0.30	
Lee				1.80	T.
Lewers Ranch	71	21	45.6	7.26	
Lovelocks*[5]	70	12	43.1	0.00	
Martins	83	14	50.3	0.98	

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Nevada—Cont'd.	°	°	°	*Ins.*	*Ins.*
Mill City*[1]	60	27	39.2	0.40	
Morey	67	12	41.8	T.	T.
Palisade	89			0.77	
Palmetto	67	5	41.0	0.00	
Potts	69	10	38.8	T.	
Reno State University	70	18	44.4	0.31	
Sodaville	72	20	46.9	0.00	
Tecoma	60	4	32.6	0.98	6.0
Toano*[1]	54	14	35.8	0.00	
Wabuska[e]	69	7	40.0	0.15	
Wadsworth*[1]	66	4	37.2	T.	
Wood	69	8	39.6	4.82	
New Hampshire.					
Alstead	68	0	32.4	1.84	2.2
Bartlett				1.20	1.7
Berlin Mills	67	0	31.6	0.77	0.8
Bethlehem	60	4	29.8	1.30	2.5
Bretton Wood				1.16	
Brookline*[1]	76	0	33.4	1.87	0.3
Chatham	71	− 2	31.2	1.10	2.0
Concord	69	1	33.0	1.38	0.7
Durham	76	8	37.0	2.04	T
Franklin Falls	67	4	32.8	1.52	2.5
Grafton	65	− 5	30.6	1.20	3.5
Hanover	69	1	31.7	0.99	0.8
Jefferson				1.41	
Keene	73	− 1	32.4	1.80	1.3
Littleton	63	5	28.8	1.29	4.0
Nashua	70	3	34.8	1.92	0.5
Newton	73	4	35.2	1.59	T.
North Stratford				1.40	8.8
North Woodstock				1.47	
Plymouth	66	− 1	31.7	1.50	2.4
Stratford	65	− 9	30.2	1.11	4.0
West Stewartstown				1.13	3.8
New Jersey.					
Asbury Park	74	15	42.9	1.09	2.0
Barnegat[f]	76	18	45.8	1.32	
Bayonne	73	14	41.0	1.05	T.
Belvidere	73	11	37.4	1.59	T.
Bergen Point	73	15	40.4	1.34	T.
Beverly	76	14	41.6	1.32	T.
Blairstown	72	10	37.0	1.30	
Bridgeton	75	15	42.2	0.94	
Canton				0.75	T.
Cape May C. H	72	15	42.3	2.03	T.
Charlotteburg	74	4	36.4	1.47	
Chester	70	10	36.0	1.65	
Clayton	73	14	40.2	0.98	0.2
College Farm	73	12	39.6	1.21	T.
Dover	76	9	35.8	1.27	T.
Elizabeth	74	14	40.7	0.91	T.
Englewood	71	15	42.4	1.03	
Essex Fells	77[e]	11[e]	38.4[e]	1.36	T.
Flemington	75	12	40.0	1.45	T.
Friesburg	75	12	41.4	0.93	T.
Hightstown	71	14	40.3	1.55	T.
Imlaystown	71	14	40.6	1.09	T.
Indian Mills	78	10	41.1	1.18	T.
Lakewood	72	13	41.0	1.02	T.
Lambertville	72	13	40.2	1.21	T.
Layton	73	3	35.0	1.70	T
Moorestown	73	14	41.4	1.18	T.
Newark	73	15	40.1	0.92	T.
New Brunswick	73	13	40.6	1.29	T.
Newton	71	8	35.4	1.44	0.5
Oceanic	72	17	42.4	0.76	T.
Paterson	79	15	41.8	1.32	T.
Pemberton	71	13	40.0	0.85	T.
Phillipsburg	71	12	38.9	1.26	T.
Plainfield	71	12	38.5	1.22	T.
Pleasantville				1.70	
Ringwood	76	6	37.6	1.38	T.
Rivervale	73	7	38.0	0.94	
Salem	76	16	41.7	1.38	
Sandy Hook	69	19	42.2	0.92	T.
Somerville	72	10	38.7	1.17	T.
South Orange	70	13	38.8	1.06	T.
Sussex	73	9	37.3	1.25	T.
Toms River	75	9	39.4	1.13	0.8
Trenton	71	18	43.6	1.63	T.
Tuckerton	75	12	41.0	1.44	0.5
Vineland	75	14	41.3	1.05	T.
Woodbine	70	10	40.0	1.69	T.
Woodstown				1.19	
New Mexico.					
Alamagordo	75	20	51.5	0.00	
Albert	81	10	48.7	0.00	
Albuquerque	76	7	42.4	0.00	
Alma	77[e]	12[e]	45.6[e]	0.00	
Arabela	78	14	50.4	0.00	
Bellranch				T.	
Cambray				0.00	
Carlsbad	97	16	57.5	0.00	
Cloudcroft	60	10	38.6	0.00	
Deming				0.00	
Dorsey	72	10	41.8	0.01	0.2
Eagle Rock Ranch	70	8	39.6	0.03	0.6

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.)			Precipitation.	
	Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.
New Mexico—Cont'd.	°	°	°	*Ins.*	*Ins.*
Fort Bayard	76	16	50.1	0.00	
Fort Stanton	74	6	43.8	0.00	
Fort Union	82	5	44.4	0.00	
Fort Wingate	73	11	44.4	0.00	
Fruitland	90	6	41.8	0.00	
Gage				0.00	
Gallinas Spring	75[d]	19[d]	46.0[d]	0.00	
Golden				0.00	
Lordsburg				0.00	
Luna	70	10	39.2	0.00	
Mesilla Park	81	17	50.0	0.00	
Mountainair	69	3	43.0	0.00	
Raton	70	9	42.2	0.01	0.1
Roswell	85	10	49.6	0.00	
San Marcial	79[g]	17[g]	48.5[g]	0.00	
Strauss				0.00	
Winsors	69	−2	36.8	0.00	
New York.					
Adams				4.66	29.5
Addison	72	8	34.6	1.84	2.5
Akron				1.69	
Alden	65	9	35.4	3.04	7.2
Amsterdam	65	6	33.6	1.85	1.1
Appleton	69	14	37.4	1.39	
Arcade	65	−9	30.8	2.47	T.
Athens	64	12	36.6	1.63	T.
Atlanta	69	4	33.2	1.84	3.0
Auburn	69	14	36.3	2.95	14.0
Avon	67	10	34.0	1.56	0.5
Baldwinsville	67	8	35.9	3.93	21.0
Bedford	72	11	39.1	2.79	T.
Berlin	65	4	33.6	1.85	T.
Bolivar	69	2	32.0	2.89	5.9
Bouckville	65	6	32.0	2.32	9.5
Boyds Corners				2.48	
Brockport	65	15	35.4	1.56	5.7
Caldwell	64	6	34.4	1.40	2.5
Canajoharie	67	9	33.4	1.43	0.6
Canaan Four Corners	63	5	32.8	2.45	T.
Carmel	67	10	35.6	3.35	
Carvers Falls	66	7	33.2	1.51	1.0
Chazy	64	5	33.3	1.51	0.1
Cooperstown	63	2	31.3	2.21	5.0
Cortland	67	0	33.0	2.24	5.2
Cutchogue	68	18	41.0	1.75	T.
Deansboro				3.03	3.0
Dekalb Junction	61	5	32.8	1.35	1.5
De Ruyter	71	−3	32.4	1.92	7.9
Easton				1.70	1.0
Elba	64	13	35.3	1.47	T.
Elmira	71	13	36.2	1.87	T.
Fayetteville	68	2	35.2	2.15	7.5
Franklinville	68	−3	31.0	2.68	7.2
Gabriels	68	−3	28.2	0.22	3.2
Gansevoort				2.17	0.5
Glens Falls	64	4	33.6	1.75	2.0
Gloversville	65	−1	32.1	2.54	1.2
Greenwich	63	6	32.6	1.81	1.0
Griffin Corners	68	−4	31.0	2.29	1.5
Harkness	68	8	33.5	0.80	1.0
Haskinville				2.25	6.2
Hemlock	65	13	35.7	1.56	0.5
Honeymead Brook	64	8	35.1	2.31	1.0
Indian Lake	65	−9	28.5	1.33	4.2
Ithaca	68	9	34.7	1.83	3.5
Jamestown	70	−6	33.4	3.95	19.8
Jeffersonville	67	0	34.0	3.00	1.5
Keene Valley	72	−1	31.2	0.84	1.9
King Ferry				2.49	7.5
Liberty	67	5	31.4	2.89	3.6
Littlefalls, City Res.	64	3	32.4	2.10	3.6
Lockport	62	14	35.2	1.43	1.8
Lowville	64	−4	30.8	2.97	18.0
Lyndonville				1.69	5.2
Lyons	69	15	36.2	2.18	4.0
Middletown	69	15	37.1	1.78	T.
Mohonk Lake	70	8	36.4	2.33	0.5
Moira	63	0	32.6	1.33	2.0
Newark Valley				2.36	3.0
New Lisbon	65	−6	30.0	2.04	4.0
North Hammond *a*		16	31.3	0.44	T.
Number Four	60	2	29.5	3.06	12.9
Ogdensburg	58	4	33.7	0.71	0.1
Oneonta	70	7	34.8	2.31	T.
Oswegatchie	64	−7	31.0	3.32	3.0
Otto				2.08	
Oxford	65	3	32.2	1.88	1.0
Oyster Bay	73	19	41.2	1.51	
Palermo				2.42	8.8
Penn Yan	70	13	37.8	1.31	T.
Perry City	66	6	33.0	2.56	6.7
Plattsburg Barracks	60	5	31.0	0.84	1.1
Port Jervis	73	8	35.8	1.99	
Potsdam	62	5	32.6	1.75	1.6
Primrose	78	10	38.5	0.43	T.
Redhook				2.31	T.
Richmondville	67	5	33.0	1.68	0.8
Ridgeway	67	14	36.6	1.81	2.8
New York—Cont'd.	°	°	°	*Ins.*	*Ins.*
Rome	64	6	34.1	3.11	13.0
Romulus	69	11	36.5	1.78	1.8
Salisbury Mills				1.97	T.
Saranac Lake	64	0	29.8	1.43	6.4
Saratoga Springs	73	3	33.8	1.99	T.
Setauket	69	20	41.0	1.32	T.
Shortsville	67	9	35.7	1.18	1.8
Skaneateles				2.95	
Southampton	67	16	40.8	1.48	0.2
South Butler	68	14	36.1	2.33	9.0
South Canisteo	69	5	32.4	2.48	4.3
Southeast Reservoir				2.89	
South Kortright	66	−5	31.6	2.23	2.0
South Schroon	70	1	31.8	1.34	3.0
Speer Falls	69	2	33.6	1.66	T.
Straits Corners	71[e]	2[e]	30.2[e]	1.91	5.0
Ticonderoga	66	10	35.7	1.21	3.5
Volusia	65	10	33.6	5.54	26.7
Walton	68	−2	32.0	2.53	4.9
Wappinger Falls	69	10	37.2	2.66	1.0
Warwick				1.66	1.0
Watertown	60	3	33.4	2.37	12.0
Waverly	70	10	34.1	2.30	4.5
Wedgwood	69	10	33.2	1.81	6.9
Wells	68	−14	30.8	1.68	5.5
West Berne	71	5	32.4	2.11	2.5
Westfield *b*	66	14	35.9	3.95	
Windham	69	4	33.8	1.76	T.
Youngstown				1.16	1.0
North Carolina.					
Brevard	71	9	42.6	2.29	
Bryson City				4.08	1.0
Chapelhill	81	15	47.2	1.71	T.
Currituck				1.24	T.
Edenton	76	24	48.8	1.96	4.0
Fayetteville	81	16	49.6	0.67	T.
Goldsboro	78	17	47.7	0.52	0.1
Graham				2.18	0.1
Greensboro	76	17	46.4	1.97	T.
Henderson	78	17	46.6	1.49	1.5
Hendersonville	72	12	42.4	2.42	
Henrietta	76	15	46.1	2.44	T.
Highlands	64	3	36.8	4.48	0.1
Horse Cove	68	9	42.7	3.57	T.
Hot Springs	86	16	48.8		
Jefferson	73	7	38.8	3.33	2.8
Kinston		14			T.
Kittyhawk	74	26	49.7	2.49	T.
Lenoir	80	12	44.8	3.06	T.
Linville	67[h]	0[e]	35.0[f]	3.83	6.0
Littleton	78	13	44.6	2.00	0.5
Louisburg	76	14	45.6	1.52	T.
Lumberton	76	15	47.6	0.35	
Marion	79	15	45.6	2.85	T.
Marshall	72[i]	12[i]	38.6[i]	3.42	7.0
Mocksville				2.19	
Moncure	80	13[e]	49.0	0.64	T.
Monroe	80	9	47.7	1.21	
Morganton	77	12	45.4	2.56	
Mountairy	78	12	42.8	1.27	0.2
Murphy				2.83	T.
Newbern	79	18	49.1	1.57	T.
Patterson *[1]	75	15	40.0	2.94	0.2
Pinehurst	80	16	49.7	0.62	T.
Pittsboro	83	15	47.7	1.00	T.
Reidsville				2.01	0.5
Rockingham	87	14	49.2	0.50	T.
Roxboro	77[k]	13[j]	48.6[j]	1.79	T.
Salem	75	14	44.2	2.15	T.
Salisbury	79	12	47.1	2.06	
Saxon	79	8	43.6	2.70	1.0
Selma	78	15	47.0	1.60	1.0
Settle *[5]	78	15	46.5	1.94	T.
Sloan	83	14	49.8	1.54	T.
Soapstone Mount	78	12	45.2	1.96	T.
Southern Pines *a*	80	16	50.0	0.45	T.
Southern Pines *b*	80[f]	16[e]	48.0[f]	0.55	T.
Southport	83	17	52.6	2.01	T.
Springhope	80	17	49.2	0.78	T.
Statesville	78	9	45.1	1.72	T.
Tarboro	82	16	48.0	0.74	0.2
Washington	82	19	49.6	1.27	0.5
Waynesville	74	9	42.7	2.75	T.
Weldon *a*	82	16	45.8	1.47	0.5
Weldon *b*				1.54	0.5
Whiteville	82	14	49.2	1.28	T.
North Dakota.					
Amenia	74	−12	23.4	0.11	1.1
Ashley	68	−13	24.6	0.10	1.0
Berlin	71	−12	22.8	0.07	0.7
Buxton	72	−13	23.6	0.03	0.3
Churchs Ferry	74	−13	23.6	0.10	1.0
Coalharbor	73			0.27	2.7
Cooperstown	69[e]	−12		T.	T.
Devils Lake	68	−8	25.0	0.20	2.0
Dickinson	74	−10	28.5	0.13	0.7
Donnybrook				0.10	1.0
Dunseith	68	−17	22.1	0.40	4.0
North Dakota—Cont'd.	°	°	°	*Ins.*	*Ins.*
Edgeley	72	−16	25.6	0.34	2.4
Elbowoods	76	−12	26.3	0.48	4.4
Ellendale	70	−5	29.8	T.	T.
Fargo	73	−15	23.6	0.10	0.9
Forman	70	−6	26.3	0.05	0.5
Fort Yates	72	−1	30.5	0.17	1.8
Fullerton	72	−8	26.4	0.10	1.0
Glenullin	70	−4	29.0	0.22	1.4
Grafton	69	−14	21.8	0.65	6.5
Hamilton	74	−18	20.8	0.86	8.6
Jamestown	73	−7	26.0	0.32	2.0
Larimore	74	−12	23.9	0.40	4.0
Lisbon	72	−9	26.8	0.10	1.0
McKinney	75	−18	23.4	0.45	4.5
Manfred	71	−10	25.8	0.28	3.3
Mayville	78	−12	27.4	0.39	3.4
Medora	70	−8	29.0	0.20	2.0
Melville	70[e]	−8[e]	24.4[e]	T.	T.
Minnewaukon	72	−9	25.9	T.	T.
Minot				T.	T.
Minto	73	−14	21.8	0.30	3.0
Napoleon	74	−13	26.2	0.22	2.0
New England	76	−10	27.6	0.25	2.5
Oakdale	72	−7	30.1	0.40	4.0
Park River	66[l]	−13[l]	21.4[l]	0.54	4.5
Pembina	74	−20	20.8	0.65	6.5
Portal	65	−13	22.0	0.90	9.0
Power	73	−10	22.4	0.10	1.0
Steele	62	−9	22.8	0.05	0.5
University	71	−11	23.0	0.60	5.0
Wahpeton	72	−6	28.6	0.15	1.5
Willow City	75	−20	20.7	0.40	4.0
Wishek	68	−10	24.6	0.30	3.0
Ohio.					
Akron	70	13	36.6	2.39	7.7
Atwater				2.44	4.0
Bangorville	77	5	37.0	2.75	4.5
Bellefontaine	72	11	29.7	2.82	3.4
Benton Ridge	70	11	37.2	1.74	5.5
Bladensburg	72	7	35.6	2.10	3.0
Bowling Green	72	8	36.3	1.42	4.0
Bucyrus	71	8	37.0	2.75	3.5
Cadiz	72	10	37.0	4.11	5.1
Cambridge	80	8	37.4	2.49	2.0
Camp Dennison	74	6	38.4	1.80	2.4
Canal Dover	70	9	35.6	2.20	4.5
Canton	67	11	36.4	2.55	2.8
Cardington	72	5	35.4	2.08	4.7
Circleville	73	9	37.8	1.83	5.0
Clarington	76	12	38.8	1.66	0.9
Clarksville	78	7	39.4	1.26	1.9
Cleveland *a*	69	16	38.4	1.97	6.8
Cleveland *b*	68	16	36.0	1.45	3.3
Clifton	75	8	38.2	1.97	2.0
Coalton	80	6	38.1	1.66	3.4
Dayton *a*				1.88	2.5
Dayton *b*	76	10	38.2	2.44	2.1
Defiance	76	4	36.6	2.08	3.6
Delaware	74	8	36.4	2.19	3.6
Demos	70	12	37.9	2.17	2.5
Elyria	72	16	37.8	2.05	5.0
Findlay	76	9	37.8	1.46	1.5
Frankfort	73	9	36.4	1.24	3.5
Fremont	72	11	37.8	2.53	3.5
Garrettsville	70	9	35.4	2.95	5.0
Granville	74	9	36.8	2.47	4.0
Gratiot	71	10	37.5	2.69	3.0
Green	73	6	39.0	2.57	3.0
Greenfield	70	12	39.3	1.62	3.0
Greenhill	69	9	34.8	1.56	2.4
Greenville	78	9	36.8	1.87	2.5
Hanging Rock	76	7	39.8	2.43	2.8
Hedges		5		1.40	2.0
Hillhouse	70	2	35.0	2.78	14.5
Hiram	68	14	35.6	2.46	6.5
Hudson	70	12	35.6	2.55	4.5
Jacksonboro	76	8	38.2	2.02	3.0
Kenton	69	2	36.7	3.24	4.5
Killbuck	72	7	36.3	1.79	3.5
Lancaster	74	11	38.6	1.78	4.0
Lima	70	7	38.0	1.78	6.5
McConnelsville	79	12	38.0	1.94	2.2
Manara	70	13	36.6	1.61	2.0
Mansfield				2.63	6.9
Marietta	72	18	41.0	1.83	
Marion	77	5	37.2	1.86	3.5
Medina	74	13	36.6	2.61	7.0
Milfordton	75[*]	7	34.5	2.51	5.5
Milligan	78	7	37.0	1.92	3.0
Millport	71	9	34.8	1.90	1.0
Montpelier	69	9	35.4	2.30	5.5
Napoleon	72	10	37.2	1.64	1.6
New Alexandria	69	11	36.6	3.84	3.0
New Berlin	73	6	34.2	2.52	5.0
New Bremen	74	6	37.6	1.98	3.5
New Richmond	78	10	41.0	1.67	1.6
New Waterford	69	11	36.0	2.25	3.1
North Lewisburg	72	7	36.4	1.90	3.5

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
	°	°	°	*Ins.*	*Ins.*
Ohio—Cont'd.					
North Royalton	70	12	37.4	3.54	17.0
Norwalk	72	9	37.4	1.64	2.5
Oberlin	72	11	36.0	2.48	6.8
Ohio State University	70	10	36.3	1.92	2.0
Orangeville	69	6	35.0	2.88	3.0
Ottawa	74	8	36.6	2.16	5.0
Pataskala	73	9	36.4	2.27	2.2
Philo	76	11	39.8	1.72	2.2
Plattsburg	74	7	37.3	2.89	5.0
Pomeroy	71	12	39.3	2.82	8.5
Portsmouth *a*				2.53	3.0
Portsmouth *b*	73	10	39.9	2.53	3.0
Pulse	79	9	39.2	1.38	3.0
Richwood	75[e]	8[e]	36.6[e]	1.82	2.5
Rittman	74	10	36.5	2.14	2.5
Rockyridge	72	8	37.5	1.60	1.0
Shenandoah	72	6	35.2	1.77	4.5
Sidney	75	8	38.2	1.85	2.4
Somerset	70	9	38.5	2.17	2.0
Springfield				1.74	2.4
Thurman	76	10	39.8	2.09	0.9
Tiffin	69	10	37.4	1.82	3.5
Upper Sandusky	70	11	37.4	1.56	3.6
Urbana	68	7	35.4	2.35	3.5
Vickery	72	7	36.3	2.02	1.2
Warren	72	13	35.8	2.71	6.6
Warsaw	76	6	35.6	2.15	
Wauseon	71	9	35.5	1.84	3.2
Waverly	79	7	39.4	1.70	2.5
Waynesville	70	7	38.3	1.93	2.5
Wellington	71	9	37.0	1.97	9.0
Willoughby				1.70	4.0
Wilson	88	3[d]	37.8	1.65	
Wooster	71	9	36.8	2.25	5.4
Zanesville				2.35	2.6
Oklahoma.					
Beaver	84	9	43.4	0.25	1.0
Binger	87	10	47.4	0.02	
Chandler	80	13	46.8	0.45	
Cloud Chief	80	8	47.2	0.03	
Eldorado	92	8	48.2	0.00	
Enid		12[g]	45.2[g]	0.55	
Fort Reno	88	10	46.9	0.00	
Fort Sill	83	10	47.0	0.00	
Grand				0.00	
Guthrie	81	13	46.9	0.21	
Hennessey	85	11	49.7	0.33	
Hobart	86	9	48.2	T.	
Jefferson[i]	80	12	41.6	T.	
Jenkins	86	10	45.4	1.13	
Kenton	77	5	45.2	0.10	1.0
Kingfisher	87	12	47.2	0.77	
McComb	81	12	47.9	0.04	
Mangum	90	15	51.1	0.30	
Meeker	79	19	47.5	0.75	
Newkirk	80	6	42.0	0.55	
Norman				T.	
Okeene				0.00	
Pawhuska	78	2	41.5	1.20	
Perry	83	12	46.0	0.81	
Sac and Fox Agency	85	11	47.8	0.45	
Shawnee	82	13	47.4	0.57	
Stillwater	84	14	45.2	0.55	
Taloga	89	12	43.6	T.	
Temple	88	8	48.9	T.	
Waukomis	85	13	48.2	0.50	
Weatherford	85	13	45.1	0.14	
Woodward	80[h]	19[h]	45.3[h]	0.32	T.
Oregon.					
Albany				11.02	
Alpha	68	28	46.2	19.96	0.2
Arlington				3.13	2.0
Ashland	77	27	46.6	8.10	2.5
Astoria	64	34	46.8	12.45	
Aurora (near)	62	30	44.4	10.47	
Bay City	66	32	47.2	17.28	
Beulah	70	9	37.4	3.49	4.5
Blackbutte	60	29	43.2	13.60	2.0
Blalock	68[c]	25[d]	41.8[d]	3.06	1.5
Burns	66[i]	7		3.53	
Burns (near)				3.74	16.0
Butter Creek				2.11	T.
Cascade Locks	61	29	42.8	16.21	1.0
Coquille				15.27	
Corvallis	64	29	45.1	11.82	
Dayville	80	22	44.8	3.44	0.2
Deschutes	66	9	39.3	4.94	9.0
Detroit				14.67	0.7
Doraville	60	26	42.0	9.56	8.1
Drain	63	33	47.3	12.00	
Ella				2.69	1.5
Eugene	59[f]	31[e]	45.0[f]	9.08	
Fairview	72	30	50.4	15.54	
Falls City	59	30	43.4	19.89	
Forestgrove	64	28	43.9	11.75	
Gardiner	73	35	52.6	16.75	
Glenora	65	30	42.0	24.58	2.0
Gold Beach	70	37	53.0	22.32	

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
	°	°	°	*Ins.*	*Ins.*
Oregon—Cont'd.					
Government Camp	79	7	36.6	15.04	61.0
Grants Pass	74	29	46.8	12.17	
Grass Valley	72	20	38.2	2.15	0.5
Hood River (near)	62[g]	23[g]	40.7[g]	7.74	
Huntington	66	14	39.6	3.83	10.0
Jacksonville	75	26	45.7	10.64	0.2
Joseph	64	5	33.6	2.72	17.0
Kerby	70	30	46.1	20.80	
Lagrande	68	19	40.6	3.01	5.0
Lakeview	70	6	37.5	4.94	4.0
Langlois	70	31	52.6	19.48	
Lonerock	74	21	41.0	4.07	7.0
McKenzie Bridge	67	24	42.1	15.34	6.0
McMinnville	68	29	45.6	13.02	
Monroe	63	28	46.0	13.23	
Mount Angel	63	31	44.4	11.17	T.
Nehalem				20.66	
Newport	65	37	49.4	12.61	
Pine	68	4	36.4	6.14	14.0
Prineville	75	17	40.8	2.08	
Salem	63	33	45.8	8.28	
Sparta	66	13	39.0	5.70	41.0
Stafford	66	32	44.4	14.06	0.5
The Dalles	66	26	42.4	4.44	6.5
Toledo	68	34	48.5	14.45	
Vale	70	13	39.4	2.32	5.0
Wallowa	65	2	34.6	4.00	13.5
Wamic	70	21	38.2	5.44	16.4
Warm Spring	79	24	41.6	3.09	1.0
Weston	78	15	39.8	5.28	5.5
Williams	75	25	46.6	12.36	2.0
Pennsylvania.					
Aleppo	72	7	36.6	2.03	T.
Altoona	72	10	36.9	1.82	
Athens	72	11	35.1	2.40	1.9
Beaver Dam				4.46	3.8
Bellefonte	71	13	37.7	1.63	1.0
Brookville				4.06	5.0
Browers				1.17	
Butler	67	10	35.6	3.43	4.0
California	75	13	40.4	2.08	1.5
Cassandra	67	10	33.1	3.99	3.0
Centerhall	69	10	37.0	1.89	
Clarion				4.12	1.8
Coatesville	76	14	40.6	1.26	0.3
Coudersport	67	5	32.2	3.94	
Confluence				2.91	2.8
Davis Island Dam				2.45	1.6
Derry	79	10	36.8	2.72	5.5
Doylestown				1.34	
Dushore	67	6	32.0	2.38	1.6
East Bloomsburg				1.60	T.
East Mauch Chunk	74	8	37.0	1.26	0.6
Easton	67	17	39.8	1.34	0.1
Ellwood Junction				2.02	4.5
Emporium	67	8	35.4	3.67	2.0
Ephrata	72	13	39.0	1.51	T.
Everett	70	12	35.0	1.33	T.
Forks of Neshaminy				1.08	
Franklin	71	9	35.4	2.51	T.
Freeport	74	11	36.9	2.91	3.0
Gettysburg	71	15	40.4	1.06	0.5
Girardville				1.87	1.5
Gordon	70	8	35.5	1.50	T.
Greensboro				1.89	1.5
Greenville	70	9	35.4	2.78	2.2
Hamburg	70	12	38.2	1.60	T.
Hamlinton	67	6	35.8	1.55	
Hawthorn	73	5	33.1	3.00	3.0
Herrs Island Dam				2.98	2.8
Huntingdon *a*				1.80	1.7
Huntingdon *b*	76	13	37.0	1.83	1.5
Indiana	68	7	35.6	2.71	3.6
Irwin	73	9	37.0	2.64	1.5
Johnstown	74	14	37.6	3.02	4.3
Kennett Square	72	15	41.0	1.17	T.
Lansdale				1.42	
Lawrenceville	75[d]	8[d]	33.7[d]	2.85	T.
Lebanon	73	13	39.3	1.28	1.0
Leroy	69	9	34.5	2.76	1.4
Lewisburg	75	10	37.6	1.69	1.0
Lockhaven *a*	74	10	37.2	1.67	2.0
Lockhaven *b*				2.58	0.5
Lock No. 4				2.06	0.7
Lycippus	68	9	37.4	2.73	5.4
Marion	69	13	37.9	1.57	0.5
Mifflin				0.45	T.
Mifflintown	71	13	36.9	1.24	0.2
Milford	75	5	35.7	1.68	
Montrose	67	4	33.4	3.04	T.
New Germantown	73	13	38.6	1.17	T.
Oil City				2.67	0.8
Ottsville				1.65	
Parker				3.92	2.8
Philadelphia	73	19	43.6	1.20	T.
Pocono Lake	66	1	31.6	1.85	
Point Pleasant				1.37	
Pottsville				1.21	

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
	°	°	°	*Ins.*	*Ins.*
Pennsylvania—Cont'd.					
Quakertown	73	11	39.4	1.38	T.
Reading	73	14	39.8	1.59	
Renovo *a*	71	10	37.0	3.74	3.0
Renovo *b*				3.64	T.
Saegerstown	72	0	34.5	2.98	5.8
St. Marys	65	8	32.9	5.33	5.0
Saltsburg				2.67	2.8
Seisholtzville				1.59	
Selinsgrove	76	11	39.2	1.53	T.
Shawmont				1.01	
Smethport	70	2	32.2	3.23	T.
Smiths Corners				1.45	
Somerset	71	7	33.1	1.62	3.4
South Eaton	69	10	36.2	2.09	T.
Springmount				1.21	
State College	66	10	36.0	1.89	1.5
Sunbury				0.50	
Swarthmore	73	13	41.4	1.12	
Towanda	70	11	35.0	2.66	1.0
Troutrun				3.48	1.5
Uniontown	73	13	37.7	2.15	2.0
Warren	68	7	34.2	2.71	9.1
Wellsboro	68	12	36.0	2.42	T.
Westchester	73	14	40.8	1.40	T.
West Newton				2.30	2.0
Wilkesbarre	67	13	36.6	1.98	T.
Williamsport	71	16	37.6	2.33	1.2
Windber				2.95	5.6
York	78	15	40.4	1.89	0.4
Rhode Island.					
Bristol	65	16	40.2	1.98	2.0
Kingston	73	9	38.0	2.50	4.0
Pawtucket	74	14	40.4	1.60	0.2
Providence *a*	71	16	40.0	1.77	2.0
Providence *c*	72	14	38.8	1.84	2.0
South Carolina.					
Aiken	82[d]	19[d]	49.8[d]	2.90	T.
Allendale	79	21	53.7	1.11	T.
Anderson	79	16	51.8	1.57	
Batesburg	85	19	51.0	3.17	0.7
Beaufort	80	25	56.8	1.64	
Bennettsville	86	16	53.9	0.30	T.
Blackville	83	19	53.1	1.65	
Bowman	79	17	52.3	0.74	T.
Calhoun Falls				0.46	
Camden				1.42	T.
Cheraw *a*	80	14	49.5	0.63	T.
Cheraw *b*				0.61	T.
Clarks Hill	81	20	51.8	2.22	
Clemson College	84	10	49.4	2.43	
Conway	80	15	52.2	0.91	T.
Darlington	82	15	51.2	0.88	T.
Edisto				0.90	T.
Effingham				1.42	T.
Florence	80	17	51.4	0.89	
Gaffney	82	15	47.8	1.08	
Georgetown	72	26	49.0	T.	
Gillisonville	83	17	54.2	1.83	
Greenville	74	16	45.5	1.95	T.
Greenwood	75	19	48.8	1.23	
Heath Springs	80	12	45.8	0.83	T.
Kingstree *a*	79[e]	15[e]	50.0[e]	0.45	T.
Kingstree *b*				0.45	T.
Liberty	76	14	48.8	2.28	T.
Little Mountain	77	20	51.0	0.89	T.
Longshore	78	12	50.0	2.21	T.
Lugoff	80	13	49.8	1.21	
Pinopolis*[1]	74	26	51.3	2.90	
St. Georges	78	17	51.8	1.75	T.
St. Matthews	78	16	51.6	1.39	T.
St. Stephens				0.96	T.
Saluda	80	17	50.6	1.81	T.
Santuck	77	13	48.8	1.22	T.
Seivern	83	15	50.2	1.30	
Smiths Mills				0.86	T.
Society Hill	78	17	49.4	0.42	T.
Spartanburg	78	16	47.2	1.82	T.
Statesburg	79	21	52.2	1.55	
Summerville	78	17	52.5	1.91	
Trenton	77	24	51.8	1.60	T.
Trial	81	13	52.0	1.02	
Walhalla	76	13	47.7	1.60	
Walterboro	82	18	55.4	2.15	
Winnsboro	77	20	51.8	1.36	
Winthrop College	76	17	49.2	1.26	T.
Yemassee	80	19	53.3	2.91	
Yorkville	78	20	50.6	0.91	
South Dakota.					
Aberdeen	75	1	29.6	0.20	0.2
Academy	74	0	33.8	0.59	6.2
Alexandria	71	0	31.0	0.45	4.5
Armour	74	−4	33.3	0.70	7.0
Ashcroft	80	−10	32.1	0.60	1.5
Bowdle[j]	47	−3	21.0	0.30	3.0
Brookings	71	−4	28.3	0.10	3.0
Canton	69	1	32.3	0.31	2.0
Centerville				0.42	3.7
Chamberlain	75	1	33.8	0.71	9.5

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
South Dakota—Cont'd.	°	°	°	*Ins.*	*Ins.*
Cherrycreek	70	— 5	29.8	0.43	5.0
Clark	74	— 5	28.0	0.36	2.6
Clear Lake	65	0	28.4	0.05	0.5
Doland	68	— 6	28.0	0.19	1.6
Elkpoint	76	4	36.0	1.57	8.0
Fairfax	72	5	34.0	0.40	4.0
Farmingdale	......	......	......	T.	T.
Faulkton	69	— 1	28.8	0.48	5.5
Flandreau	71	— 1	29.4	0.38	3.8
Forestburg	72	—10	30.4	0.87	5.1
Fort Meade	74	— 4	33.2	0.80	8.0
Gannvalley	76	— 5	30.8	0.84	12.0
Gettysburg	64	— 2	28.8	0.15	2.0
Grand River School	......	......	......	0.03	1.0
Greenwood	70	4	35.6	0.66	5.0
Highmore	......	......	......	0.65	6.5
Hotch City	75	— 4	31.4	0.39	6.5
Howard	70[e]	0[e]	31.4[e]	0.70	7.0
Howell	72	— 6	28.6	0.26	2.8
Ipswich	70	— 8	37.2	0.02	0.1
Kidder	69	— 6	26.2	0.02	T.
Kimball	75	— 1	31.4	0.77	7.7
Leola	70	— 6	29.0	0.05	1.0
Marion	70[e]	1[e]	30.5[f]	0.24	3.0
Mellette	73	— 6	30.4	0.14	1.4
Menno	68	1	32.8	0.39	5.3
Oelrichs	74	— 8	31.2	0.20	2.0
Pedro	72	1	31.8	0.18	2.0
Pine Ridge	75	— 5	33.3	0.07	1.5
Plankinton	70	— 2	31.4	0.29	7.5
Ramsey	70	— 5	29.5	0.30	3.5
Redfield	76	—10	27.9	0.16	2.5
Rosebud	......	......	......	0.45	5.0
Silver City	......	......	......	0.36	2.0
Sioux Falls [f]	68	— 1	28.4	0.13	1.5
Sisseton Agency	68	— 2	28.6	T.	T.
Spearfish	73	— 2	33.9	0.65	9.0
Stephan	71	— 3	29.6	0.50	5.7
Tyndall	69	1	34.0	0.52	3.4
Watertown	69	— 5	28.6	0.14	1.4
Wentworth	69	— 8	28.8	0.33	2.2
Wolsey	......	......	......	0.47	4.2
Tennessee.					
Andersonville	75	9	42.8	4.95	0.5
Ashwood	75	15	46.5	4.63	
Benton	77	11	45.3	4.15	
Bluff City	......	......	......	3.25	3.1
Bolivar	76	15	46.8	3.27	
Bristol	72	11	40.7	3.65	3.0
Byrdstown	75	11	43.1	4.51	1.6
Carthage	79	16	45.9	4.54	T.
Charleston	......	......	......	3.46	
Clarksville	74	16	45.2	3.34	1.1
Clinton	......	......	......	5.14	1.0
Covington	77	17	47.4	3.10	
Decatur	76	12	45.0	4.12	T.
Dickson	75	14	44.9	4.18	0.1
Dover	80	14	46.4	5.53	2.0
Elizabethton	76	11	41.8	3.37	5.0
Erasmus	74	5	41.3	4.61	0.3
Florence	75	16	45.8	4.68	T.
Franklin	72	16	44.8	4.81	T.
Grace *[1]	82	16	47.0	8.20	
Greeneville	76	13	43.9	3.48	2.9
Halls Hill	......	......	......	7.42	T.
Harriman	75	14	43.8	3.80	T.
Hohenwald	76	9	43.5	3.27	0.2
Iron City	74	11	45.8	3.97	
Isabella	72	15	44.8	3.23	T.
Jackson	78	11	46.2	4.63	
Johnsonville	76	12	45.6	3.12	T.
Jonesboro	75	13	42.4	4.64	3.6
Kenton	79	15	45.8	3.29	1.0
Kingston	......	......	......	3.56	
Lafayette	74	11	43.6	4.31	T.
Leadvale	......	......	......	3.07	0.2
Lebanon	78	12	46.6	6.48	
Lewisburg	76	14	46.2	4.88	0.5
Liberty	85	12	45.2	4.81	T.
Lynnville	76	16	47.0	4.57	T.
McKenzie	75	11	46.1	......	
McMinnville	76	11	45.0	3.66	1.7
Maryville	76	13	45.2	3.57	T.
Newport	75	14	44.0	3.13	2.5
Palmetto	75	13	46.0	4.50	T.
Pope	80	10	47.4	2.55	T.
Rogersville	75	11	43.4	2.94	2.0
Rugby	75	4	40.8	3.82	2.5
Savannah	79	15	48.4	3.96	
Sewanee	71	11	43.9	3.94	T.
Silverlake	68	4	38.5	3.86	7.8
Springdale	74	7	42.6	5.00	T.
Springville	76	13	45.8	5.94	0.2
Tazewell	......	......	......	4.36	1.3
Tellico Plains	78	15	47.0	5.37	T.
Trenton	80	14	47.6	3.10	0.2
Tullahoma	75	14	45.5	3.80	T.
Waynesboro	78	12	47.4	3.03	T.
Tennessee—Cont'd.	°	°	°	*Ins.*	*Ins.*
Wildersville	72	16	46.5	3.58	T.
Yukon	73	15	47.4	4.21	
Texas.					
Albany	80	20	53.3	0.53	
Alvin	85	30	60.0	0.14	
Arthur	......	......	......	0.78	
Austin *a*	84	27	58.4	T.	
Austin *b* *[5]	81	23	56.7	......	
Ballinger	84	21	53.2	0.00	
Beaumont	......	......	......	0.36	
Beeville	95	34	62.9	0.14	
Bigspring	87	15	54.4	0.00	
Blanco	87	26	54.6	0.00	
Boerne *[1]	90	25	56.1	T.	
Bonham	88	18	51.6	0.00	
Booth	......	......	......	0.85	
Bowie	86	13	51.8	0.00	
Brenham	85	28	58.6	0.90	
Brighton	83	35	64.0	0.80	
Brownwood	89	21	54.9	0.00	
Burnet	90	23	56.4	0.13	
Camp Eagle Pass	89	24	58.0	0.00	
Childress	88	12	50.2	0.00	
Coleman	87	21	56.7	0.00	
College Station	85	27	59.6	0.44	
Colorado	90	13	54.3	0.00	
Columbia	83	33	64.9	0.16	
Columbus	......	......	......	0.00	
Corsicana	85	22	55.4	0.23	
Cotulla	90	31	62.8	0.00	
Cuero	86	32	58.0	1.38	
Dallas	88	18	52.4	0.00	
Dialville	82[f]	22	56.2[d]	T.	
Dublin	82	25	51.4	0.00	
Duval	83	26	58.7	0.06	
Estelle	87	19	53.8	0.00	
Fort Brown	89	40	67.8	0.00	
Fort Clark	85	29	55.4	0.00	
Fort Davis	82	15	52.2	0.00	
Fort McIntosh	96	31	64.4	0.00	
Fort Ringgold	95	34	66.8	0.10	
Fort Stockton	......	......	......	0.00	
Fredericksburg	83	26	56.0	0.00	
Gainesville	81	16	50.2	0.00	
Gatesville	......	......	......	0.00	
Georgetown	97	25	58.5	0.00	
Grapevine	87[d]	19[d]	53.8[d]	0.00	
Greenville	85	20	52.6	0.00	
Hale Center	83	17	51.0	0.00	
Hallettsville	84	32	60.6	0.55	
Haskell	90	9	53.1	0.04	
Hearne	90	35	63.0	0.00	
Hempstead	......	......	......	0.04	
Henrietta	91	13	52.6	0.00	
Hewitt	......	......	......	0.20	
Hillsboro	87	21	54.0	0.00	
Hondo	86	32	59.2	T.	
Houston	86	31	59.2	1.12	
Huntsville	......	......	......	1.44	
Ira	91	17	55.0	0.00	
Jasper	87[d]	23	57.9[d]	0.50	
Jefferson	83	16	53.0	0.05	
Junction	......	......	......	0.00	
Kaufman	83	21	53.4	T.	
Kent	85	17	55.8	0.00	
Kerrville	90	30	64.1	0.00	
Kopperl	......	......	......	0.00	
Lampasas	92	22	54.4	0.00	
Liberty	......	......	......	0.00	
Llano	91	30	57.2	0.00	
Longview	93	21	52.8	0.65	
Luling	85	26	57.2	0.10	
Marlin	82	21	54.8	0.95	
Menardville	......	17	......	0.00	
Mount Blanco	84	11	49.0	0.00	
Nacogdoches	85	17	54.2	0.37	
New Braunfels	85	31	59.6	0.00	
Orange	......	......	......	0.00	
Panter	......	......	......	T.	
Pearsall	30	33	62.4	T.	
Port Lavaca	83	35	62.4	0.73	
Rhineland	90	12	50.9	0.00	
Riverside	......	......	......	0.08	
Rockisland	83	30	60.0	0.15	
Rockland	......	......	......	0.72	
Rockport	78	40	62.0	0.00	
Runge	87[h]	31[h]	60.8[h]	0.09	
Sabinal	......	......	......	0.00	
San Saba	90	22	55.9	0.00	
Santa Gertrudes Ranch	......	......	......	0.00	
Sherman	80	22	54.8	T.	
Sonora	88	23	54.6	T.	
Sugarland	86	29	59.8	0.00	
Sulphur Springs	84	19	53.0	T.	
Temple *a*	82	22	52.5	0.00	
Temple *b*	83	21	54.4	0.05	
Tilden	97	22	61.5	0.00	
Trinity	85	22	56.9	0.05	
Texas—Cont'd.	°	°	°	*Ins.*	*Ins.*
Tulia	83	8	48.1	0.00	
Tyler	83	21	53.3	0.47	
Victoria	86[e]	33[e]	62.1[e]	0.50	
Waco	88	24	56.3	0.00	
Waxahachie	88	21	52.4	0.30	
Weatherford	83	18	52.8	T.	
Wichita Falls	......	......	......	0.00	
Utah.					
Alpine	......	......	......	1.34	
Aneth	70	12	42.0	0.00	
Blackrock	70	5	39.4	0.10	1.0
Bluecreek	75	10	41.5	0.40	4.0
Callao	74	1	35.9	0.16	
Castledale	70	— 3	34.8	T.	
Corinne	74	17	38.7	2.03	6.0
Coyoto [d]	69	0	37.6	0.00	
Deseret	73	— 2	37.4	T.	T.
Emery	65	0	38.4	0.00	
Escalante	65	12	39.8	0.00	
Farmington	68	13	39.1	1.86	7.6
Fillmore [a]	71	9	42.0	......	
Fort Duchesne	64[i]	— 1[i]	31.8[i]	0.00	
Frisco	64	15	43.4	0.02	
Garrison	70	2	40.8	T.	T.
Giles	65	6	37.0	0.00	
Government Creek	66	9	39.8	0.54	2.5
Green River	78	5	39.8	0.00	
Grover	71	6	40.4	......	
Heber	67	6	36.8	1.90	1.0
Henefer	72	—19	35.2	3.27	20.0
Hite	73	20	48.0	0.00	
Huntsville	......	......	......	2.30	12.0
Ibapah	71	— 6	36.3	0.37	2.0
Levan	65	8	38.4	0.24	2.3
Logan	67	5	35.3	2.29	......
Lund	65	14	38.8	0.00	
Manti	70	7	38.4	0.20	2.0
Marysvale	70	5	40.6	T.	T.
Meadowville	62	2	32.0	3.20	17.0
Millville	......	......	......	3.34	
Moab	75	10	42.4	0.00	
Monticello	70	7	44.2	0.00	
Morgan	71	—14	35.3	3.01	14.0
Mount Nebo	70	7	39.8	T.	
Mount Pleasant	69	8	40.6	0.20	2.0
Ogden	68	12	38.8	1.74	......
Park City	64	0	37.8	2.47	21.7
Parowan	68	10	40.6	T.	T.
Pinto	67	8	37.8	0.00	
Plateau	76	— 3	39.7	0.02	0.3
Provo	73	3	39.8	1.14	3.4
Ranch	70	12	40.2	T.	
St. George	76	18	44.8	0.00	
Salt Air	66	19	39.4	1.71	6.5
Scipio	71	— 1	38.9	0.48	3.0
Snowville	64	2	33.4	1.87	
Terrace	62	9	35.4	1.30	13.0
Thistle	80	19	43.6	0.80	5.0
Tooele	68	16	39.4	1.64	
Vernal	64	5	35.6	0.18	T.
Wellington	78	1	37.2	0.00	
Vermont.					
Burlington	61	14	35.8	1.21	1.5
Cavendish	70	— 1	33.0	1.02	1.9
Chelsea	61	— 1	29.0	1.02	5.0
Cornwall	66	7	35.0	2.10	......
Derby	61	3	30.4	1.58	......
Enosburg Falls	64	— 4	29.8	1.63	9.6
Jacksonville	59	— 6	24.8	1.91	5.3
Manchester	60	— 1	32.2	2.14	2.0
Morrisville	62	— 2	30.4	2.00	9.7
Norwich	66	— 1	30.6	1.02	2.0
St. Johnsbury	66	2	30.9	1.00	3.0
Wells	60	6	31.4	1.85	1.0
Woodstock	77	0	33.5	1.38	......
Virginia.					
Ashland	75	16	43.0	1.87	0.5
Barboursville	75	16	44.6	0.76	0.7
Bedford	80	19	45.8	......	
Bigstone Gap	77	6	42.1	3.64	5.4
Blacksburg	79	8	37.6	1.94	3.0
Boykins	......	......	......	1.25	1.5
Buckingham [j]	75	10	39.1	0.68	0.4
Burkes Garden	67	0	34.5	3.67	12.0
Callaville	78	16	45.9	1.95	
Charlottesville	76	15	45.7	0.80	1.0
Clarksville	......	......	......	1.55	4.0
Columbia	75	8	44.2	0.75	0.5
Dale Enterprise	74	7	39.7	0.71	1.0
Danville	......	......	......	2.11	0.5
Elk Knob	71	7	41.9	3.16	4.5
Farmville [g]	78	17	48.8	1.90	
Fredericksburg	76	12	42.4	1.30	0.8
Hampton	73	21	46.6	2.53	0.2
Hot Springs	70	0	35.7	1.40	1.5
Lexington	80	7	41.1	1.61	3.0
Lincoln	74	13	39.8	0.87	0.5
Marion	73[e]	5[e]	38.8[e]	3.95	7.5

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.)			Precipitation.	
	Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.
Virginia—Cont'd.	°	°	°	*Ins.*	*Ins.*
McDowell	78	5	39.0	0.13	0.5
Mendota				3.13	3.5
Newport News	78	22	44.8	2.60	T.
Petersburg	77	18	45.6	1.33	0.2
Quantico	76	13	44.2		
Radford				0.98	4.0
Riverton				0.14	
Roanoke	62	11	37.0	1.88	3.5
Rockymount	67	11	38.8	1.68	3.0
Saxe	80	8	44.0	1.59	T.
Shenandoah				0.81	0.1
Speers Ferry				3.78	6.0
Spottsville	80	16	45.2	2.94	0.5
Stanardsville [j]	75	16	42.2	0.70	1.0
Staunton	74	10	41.5	0.98	1.0
Stephens City	78	13	40.5	0.81	0.8
Warsaw	74[e]	16[e]	40.6[e]	1.71	1.5
Wilkerson	73	15	44.0	1.23	1.0
Williamsburg	74	16	44.8	2.15	
Woodstock	76	14	41.4	0.70	0.6
Wytheville	77	8	39.8	2.26	12.5
Washington.					
Aberdeen	60	31	44.6	19.75	T.
Anacortes				4.96	
Ashford				15.03	23.5
Blaine	62	24	43.6	8.31	0.7
Bremerton	62	30	44.2	9.98	
Brinnon	64	28	43.4	16.68	13.0
Cedonia	63	3	33.0	2.82	16.5
Centralia	66	25	44.3	9.52	T.
Cheney				3.15	11.0
Clearbrook	66	19	41.0	9.26	2.0
Clearwater	58	28	43.2	24.84	T.
Cle Elum	58	10	33.2	6.35	36.0
Colfax	73	9	40.2	3.94	T.
Colville	70	− 5	33.0	1.82	10.9
Conconully	59	− 5	31.6	3.50	22.0
Connell				2.25	2.0
Coupeville	65	28	45.2	4.36	7.0
Crescent	64	7	33.4	4.16	14.5
Danville	61	0	33.8	1.99	5.7
Dayton	79	19	42.4	4.01	5.0
East Sound	63[f]	26[f]	42.8[f]	5.64	2.0
Ellensburg	58	3	33.0	3.59	25.5
Ephrata	62	15	35.1	1.41	12.0
Grandmound	66	27	43.8	10.30	1.0
Granite Falls				12.73	4.5
Hooper	77[m]	21[m]	45.0[m]	2.19	0.5
Horseheaven				1.88	11.6
Lacenter	65	28	43.2	11.32	T.
Lakeside	56	15	35.8	3.21	19.5
Lind	70	16	39.2	2.95	7.5
Loomis	64	3	33.2	3.10	14.0
Mayfield	73			14.59	4.0
Mottinger Ranch	67	27	43.0	2.08	0.8
Mount Pleasant	65	30	45.5	11.37	
Moxee	64	12	36.6	2.65	17.1
Northport	56	− 4	33.2	1.54	6.5
Odessa	73	18	37.2	2.59	3.5
Olga	62	27	43.9	5.75	T.
Olympia	69	29	45.5	11.72	T.
Pinehill	59	21	40.4	6.05	11.0
Pomeroy	73	23	42.1	4.19	6.5
Port Townsend	63	32	45.0	3.73	T.
Pullman	67[t]	17[e]	38.6[d]	3.08	8.0
Rattlesnake	64	12	34.4	2.13	6.6
Republic	64	− 7	31.0	2.51	14.0
Ritzville				1.91	2.0
Ritzville (near)				2.82	4.0
Rosalia	71	15	38.3	3.34	3.7
Sedro-Woolley	67	26	44.8	7.25	T.
Silvana	63[d]	24[d]	45.4[d]	5.84	1.0
Snohomish	63	22	45.4	7.41	T.
Southbend	65	32	46.6	14.03	
South Ellensburg	64	4	34.8	3.20	22.0
Sprague				3.95	5.0
Sunnyside	65	24	39.0	1.44	4.5
Trinidad	67	16	36.0	2.70	14.0
Twisp	57	3	30.6	2.50	22.0
Union	66[i]	29[h]	42.8[h]	15.56	6.0
Usk	53[k]	− 1[k]	33.6[k]	4.70	22.0
Vancouver	67	28	45.0	9.34	
Vashon	65	30	45.0	9.65	
Waterville	58	1	30.6	3.00	24.0
Wenatchee (near)	57	15	33.4	4.05	33.5
Whatcom	67	23	45.4	5.47	1.5
Wilbur	68	3	32.2	2.26	7.0
Zindel	67	27	45.0	1.89	1.5
West Virginia.					
Bayard	70	4	32.6	1.88	4.3
Beverly	72	6	34.6	2.72	5.0
Bluefield	78	11	44.4	2.20	
Burlington	74	10	36.6	0.83	T.
Cairo	76	6	38.7	3.25	4.0
Central	74	7	37.8	3.51	2.9
Charleston				2.16	1.5
Creston	70	10	39.4	2.90	4.0
Cuba	78	9	38.4	2.89	5.8

Stations.	Temperature. (Fahrenheit.)			Precipitation.	
	Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.
West Virginia—Cont'd.	°	°	°	*Ins.*	*Ins.*
Elkhorn	75	9	41.3	3.47	10.1
Fairmont				2.70	1.0
Glenville	76	10	37.3	3.01	4.0
Grafton	74	8	38.3	3.62	10.5
Green Sulphur Springs	78	4	37.9	1.60	6.0
Harpers Ferry				0.79	0.2
Hinton	75	9	40.2	2.24	5.5
Huntington	72	11	38.4	2.38	4.0
Josiah	71	12	39.6	2.53	4.5
Leonard	72	4	35.1	2.85	10.0
Lewisburg	71	6	36.8	1.86	4.0
Logan	76	11	43.4	3.15	11.0
Lost Creek	74	8	37.4	2.91	1.5
Mannington	72	1	36.4	2.63	1.3
Marlinton	73	9	33.4	0.93	3.0
Martinsburg	73	16	38.2	0.85	0.5
Morgantown	73	10	38.6	2.26	3.0
Moscow	70	12	37.2	2.38	T.
Moundsville	71	12	38.8	1.95	2.6
New Martinsville	73	12	40.6	2.30	2.5
Nuttallburg	76	10	43.6	3.10	9.0
Philippi	75	− 1	37.2	3.41	5.1
Pickens	75	3	37.1	4.98	18.5
Point Pleasant	75	14	41.2	2.64	4.0
Powellton	74	0	36.8	1.67	4.6
Princeton	70	8	37.8	4.30	13.0
Romney	76	11	38.8	0.92	1.0
Rowlesburg				2.83	
Ryan	78	6	38.8	2.35	4.5
Southside	73	14	42.6	2.65	4.0
Spencer	79	9	40.6	2.72	5.5
Terra Alta	70	5	34.2	3.90	6.0
Travellers Repose	71	− 4	32.6	2.00	5.0
Uppertract	75	6	39.6	0.67	
Valley Fork	75	0	39.6	3.44	4.0
Webster Springs	76	3	37.7		
Wellsburg	68	11	36.2	3.36	4.0
Weston				3.03	4.5
Wheeling *a*				2.08	1.8
Wheeling *b*	69	20	40.6	2.05	2.5
Wisconsin.					
Amherst	70	− 4	29.8	1.15	8.5
Ashland				0.80	5.0
Antigo	67	− 6	28.2	0.80	8.0
Appleton	68	6	32.4	1.24	3.6
Appleton Marsh	72	0	29.5	0.48	2.5
Barron*	70	− 8	25.0	0.50	5.0
Beloit	67	7	33.9	1.14	0.7
Brodhead	73	3	34.0	1.18	1.5
Burnett	69	2	31.9	1.20	3.4
Butternut	69	− 4	27.8	1.26	11.9
Chilton	70	5	30.3	1.46	5.8
Citypoint	74	− 4	30.2	0.69	6.5
Dodgeville	71	3	34.4	1.60	4.0
Downing	74	− 12	27.8	0.52	4.7
Durand	71	0	34.2		
Easton	68	− 4	29.8	0.60	1.8
Eau Claire	67	− 5	29.3	0.65	6.0
Florence	80	− 6	28.6	1.53	6.0
Fond du Lac	67	5	32.6	1.34	3.0
Grand Rapids	69	− 6	29.4	1.08	2.5
Grand River Locks				1.63	2.5
Grantsburg	68	−14	26.0	0.60	6.0
Hancock	67	− 2	29.2	0.68	5.0
Harvey	68	7	32.2	1.02	1.8
Hayward	70	−11	26.2	1.48	10.0
Hillsboro	69	− 1	30.9	0.55	0.5
Koepenick	75	3	29.7	1.40	12.0
Lancaster	70	2	31.7	0.60	1.0
Madison	64	9	32.7	1.07	1.0
Manitowoc	68	8	33.2	1.12	4.9
Meadow Valley	72	− 1	28.5	0.83	4.0
Medford	71	− 5	27.9	0.90	9.0
Menasha				0.91	5.0
Minocqua	65	3	29.6	1.05	12.0
Neillsville	72	− 2	28.6	1.13	4.0
New London	71	0	29.6	1.17	3.0
North Crandon [j]	65	−12	28.1	0.20	2.0
Oconto	70	2	31.3	0.76	6.0
Osceola	70	−15	27.4	0.20	2.0
Oshkosh	75	4	31.8	1.37	3.3
Pine River	72[e]	0	32.0	1.00	6.5
Portage	71	7	33.7	1.08	3.0
Port Washington	66	4	29.4	1.68	6.5
Prairie du Chien *a*	75	6	38.5	0.27	T.
Prairie du Chien *b*				0.22	T.
Prentice	68	− 6	26.4	0.86	7.4
Racine	67	11	35.8	0.73	1.0
Sheboygan	64	9	34.2	1.79	5.0
Spooner	69	−10	27.2	0.49	4.9
Stanley	70	− 4	27.4	0.58	6.2
Stevens Point	70	− 6	29.2	1.44	7.0
Valley Junction	74	1	30.6	0.50	6.0
Viroqua	70	4	30.6	0.47	0.8
Washburn	71	4	30.6	1.00	6.0
Watertown	68	6	31.3	1.44	2.0
Waukesha	68	8	33.0	1.01	1.9
Waupaca				1.08	3.5

Stations.	Temperature. (Fahrenheit.)			Precipitation.	
	Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.
Wisconsin—Cont'd.	°	°	°	*Ins.*	*Ins.*
Wausau	67	− 1	28.2	0.88	
Whitehall	70[e]	− 4[e]	31.2[e]	0.17	1.8
Wyoming.					
Afton	66	−16	31.6	1.51	13.0
Alcova	64	10	35.5	T.	T.
Basin	69	−12	30.4	T.	T.
Battle	54	−10	25.5	6.20	62.0
Bedford	62	−12	30.0	1.26	10.3
Border	65	−29	24.4	1.95	
Buffalo	71	−26	30.2	0.35	3.2
Chugwater	71	−10	36.2	0.50	5.0
Daniel	60	−29	23.5	1.30	13.0
Evanston	62	−10	31.4	1.62	8.5
Fontenelle	62	−22	25.8	0.95	9.5
Fort Laramie	77	− 8	35.6	0.57	2.0
Fort Washakie	63	− 5	35.0	0.00	
Fort Yellowstone	60	−10	31.8	1.40	11.0
Fourbear	65	−12	31.8	0.20	4.0
Griggs	71	−12	33.5	0.58	5.8
Hyattville	68	−14	33.8		
Laramie	62	− 6	34.8	0.30	6.0
Leo	60	− 7	33.2	0.21	3.0
Lolabama Ranch	60	−23	29.6	0.91	6.5
Lusk	72	−15	32.1	0.26	
Marquette	70	−16	35.0	0.92	6.0
Moore	69	− 9	38.2	0.72	7.0
Moorcroft	70	−15	31.2	0.30	3.0
Pinebluff	78	−15	37.4	T.	T.
Phillips	75	−11	36.7	0.50	5.0
Rawlins	66	6	35.6	0.49	3.3
Redbank	67	−12	35.0	1.40	
South Pass	62	−18	26.2	3.10	31.0
Thayne	65	−16	29.5	1.70	11.6
Thermopolis	50	−16	26.0	0.15	1.5
Porto Rico.					
Adjuntas	97	54	73.3	14.55	
Aguirre	93	67	79.5	2.78	
Arecibo	89	64	77.0	5.05	
Barros	87	57	71.6	11.81	
Bayamon	95	60	77.4	2.04	
Caguas	91	61	76.2	8.51	
Canovanas	87	70	77.8	6.85	
Cayey	85	60	72.6	6.42	
Cidra	90	54	72.9	3.60	
Carozal	91	55	74.2	11.34	
Fajardo	90	69	79.0	5.87	
Guanica	91	60	77.4	5.09	
Hacienda Josefa				2.63	
Hacienda Perla	85	70	75.8	10.14	
Humacao	81	68	79.8	4.78	
Isabela	87	66	76.7	4.66	
La Carmelita	86	63	74.0	17.02	
La Isolina	89	62	74.7	12.34	
Lares	88	59	74.0	9.75	
Las Marias	93	66	78.6	12.45	
Manati	94	65	77.4	5.02	
Maunabo	91	65	78.2	8.77	
Mayaguez	90	63	77.1	6.48	
Morovis	91	63	76.7	13.23	
Rio Piedras				7.81	
San German	96	61	78.9	15.52	
San Lorenzo	91	59	75.0	5.87	
San Salvador	87	61	73.2	10.60	
Santa Isabel	90	68	77.7	7.24	
Vieques	91	66	76.5	3.18	
Yauco	87	64	76.8	6.50	
Mexico.					
Ciudad P. Diaz	80	24	55.4	T.	
Coatzacoalcos	93	50	72.8	10.29	
Durango	73	52	62.9	T.	
Leon de Aldamas	79	38	58.8	T.	
New Brunswick.					
St. John	58	13	35.5	6.61	9.0
Isthmus of Panama.					
Alhajuela	91	73	80.8	16.30	
Bohio				20.91	
Colon				28.31	
Gamboa				11.93	
La Boca	84	71	76.6	8.66	
West Indies.					
Columbia, Isle of Pines	93	48	73.8	0.25	

Late reports for October, 1903.

Alaska.					
Coal Harbor	55	22	37.5	2.52	1.2
Copper Center	52	−11	26.4	1.71	15.2
Kenai	59	− 2	31.2	0.77	10.2
Mine Harbor	55	18	36.6	3.97	16.0
Sunrise	52	8	32.5	2.61	7.3
Wood Island	54	26	40.7	6.27	4.2
Arizona.					
Champie Camp	99	38	69.6	0.02	
Greaterville	86	32	61.6	0.00	
California.					
Boca*[1]	80	20	43.3	T.	

TABLE II.—*Climatological record of voluntary and other cooperating observers. Late reports for October*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
	°	°	°	*Ins.*	*Ins.*
California—Cont'd.					
Cisco *[1]	72	26	51.1	1.00	
Corning *[1]	95	48	69.6	0.15	
Delano *[1]	89	56	68.6	0.00	
Delta *[1]	90	46	62.7	5.17	
Dunnigan *[1]	90	49	69.4	0.36	
Mammoth	97	49	74.4	0.00	
Modesto *[1]	101	49	65.4	0.00	
Mohave	90	45	61.7	0.00	
Monterey *[1]	80	48	58.4	0.00	
Ogilby *[1]	102	60	75.3	0.00	
Salton	99	46	73.4	0.00	
San Mateo *[1]	88	50	63.0	0.29	
San Miguel *[1]	93	38	64.2	0.00	
San Miguel Island	85	52	61.3	0.30	
Sisson	80	28	52.6	1.75	
Tehama *[1]	90	49	66.4	0.39	
Truckee *[1]	84	30	52.6	1.02	
Volcano Springs	102	42	75.2	0.00	
Georgia.					
Eastman	91	34	65.5	2.63	
Woodbury	86	28	60.2	1.51	
Idaho.					
Roosevelt	78[h]	16[h]	44.8[h]	1.14	5.0
Indiana.					
Mount Vernon	83	28	58.1	1.05	
Winamac	86[e]	20[e]	55.4[e]	4.02	
Indian Territory.					
Durant	88[e]	35	61.4	4.92	
Kansas.					
Eureka	......	......	......	6.46	
Maryland.					
Darlington	78	29	55.2	4.20	T.
McDonogh	80	32	56.6	2.36	

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
	°	°	°	*Ins.*	*Ins.*
Massachusetts.					
East Templeton *[1]	72	26	48.4	3.02	T.
Michigan.					
Berrien Springs	84[e]	30[e]	53.0[e]	2.50	T.
Deer Park	71	30	46.6	2.46	T.
New Jersey.					
Clayton	79	30	56.4	......	
Englewood	76	32	56.6	11.75	
New Mexico.					
Luna	77	10	43.8	0.00	
New York.					
Boyds Corners	......	......	......	8.59	
Southeast Reservoir	......	......	......	6.90	
North Carolina.					
Highlands	73	15	47,8	4.29	
Springhope	85	30	59.8	4.47	
North Dakota.					
Minot	76	......	......	0.90	
Oklahoma.					
Enid	90	33	60.8	4.83	
Oregon.					
Burns (near)	......	......	......	0.29	
South Carolina.					
Pinopolis *[1]	80	37	61.9	3.73	
Texas.					
Fredericksburg	88	34	63.7	2.30	
La Para	......	......	......	2.28	
Marlin	93	40	66.5	2.51	
Utah.					
Bluecreek	78	......	......	1.55	
Porto Rico.					
Cayey	92	59	75.9	7.40	
Cidra	90	50	71.2	7.15	
San German	96	67	81.0	12.03	

EXPLANATION OF SIGNS.

*Extremes of temperature from observed readings of dry thermometer.

A numeral following the name of a station indicates the hours of observation from which the mean temperature was obtained, thus:

[1] Mean of 7 a. m. + 2 p. m. + 9 p. m. + 9 p. m. ÷ 4.
[2] Mean of 8 a. m. + 8 p. m. ÷ 2.
[3] Mean of 7 a. m. + 7 p. m. ÷ 2.
[4] Mean of 6 a. m. + 6 p. m. ÷ 2.
[5] Mean of 7 a. m. + 2 p. m. ÷ 2.
[6] Mean of readings at various hours reduced to true daily mean by special tables.

The absence of a numeral indicates that the mean temperature has been obtained from daily readings of the maximum and minimum thermometers.

An italic letter following the name of a station, as "Livingston *a*," "Livingston *b*," indicates that two or more observers, as the case may be, are reporting from the same station. A small roman letter following the name of a station, or in figure columns, indicates the number of days missing from the record; for instance "n" denotes 14 days missing.

No note is made of breaks in the continuity of temperature records when the same do not exceed two days. All known breaks, of whatever duration, in the precipitation record receive appropriate notice.

TABLE III.—*Resultant winds from observations at 8 a. m. and 8 p. m., daily, during the month of November, 1903.*

Stations.	Component direction from—				Resultant.	
	N.	S.	E.	W.	Direction from—	Duration.
New England.	*Hours.*	*Hours.*	*Hours.*	*Hours.*	°	*Hours.*
Eastport, Me	24	10	8	30	n. 58 w.	26
Portland, Me	22	17	3	32	n. 80 w.	29
Concord, N. H. †	10	7	4	16	n. 76 w.	12
Northfield, Vt	22	31	2	12	s. 48 w.	14
Boston, Mass	19	6	4	40	n. 70 w.	38
Nantucket, Mass	26	11	4	31	n. 61 w.	31
Block Island, R. I	29	8	6	32	n. 51 w.	33
Narragansett, R. I.*	10	8	4	14	n. 79 w.	10
New Haven, Conn	36	6	2	24	n. 36 w.	37
Middle Atlantic States.						
Albany, N. Y	26	18	6	21	n. 62 w.	17
Binghamton, N. Y.†	10	1	10	14	n. 24 w.	10
New York, N. Y	21	10	6	38	n. 71 w.	34
Harrisburg, Pa	25	11	8	31	n. 59 w.	27
Philadelphia, Pa	33	11	4	31	n. 51 w.	35
Scranton, Pa	25	13	11	25	n. 49 w.	18
Atlantic City, N. J	30	8	3	35	n. 56 w.	39
Cape May, N. J	31	10	5	26	n. 45 w.	30
Baltimore, Md	29	10	4	32	n. 56 w.	34
Washington, D. C	26	14	8	27	n. 58 w.	22
Cape Henry, Va.†	14	8	3	12	n. 56 w.	11
Lynchburg, Va	21	16	13	27	n. 70 w.	15
Norfolk, Va	29	18	8	16	n. 36 w.	14
Richmond, Va	30	16	7	19	n. 41 w.	18
Wytheville, Va	19	9	8	37	n. 71 w.	31
South Atlantic States.						
Asheville, N. C	25	19	14	24	n. 59 w.	12
Charlotte, N. C	22	20	23	12	n. 80 e.	11
Hatteras, N. C	34	9	13	17	n. 9 w.	25
Kittyhawk, N. C. *	.....	.....	.....	.....	.....	.....
Raleigh, N. C	29	9	11	19	n. 22 w.	22
Wilmington, N. C	32	11	12	17	n. 13 w.	22
Charleston, S. C	30	10	14	16	n. 6 w.	20
Columbia, S. C	24	13	22	16	n. 29 e.	12
Augusta, Ga	24	9	25	19	n. 22 e.	16
Savannah, Ga	30	11	10	19	n. 25 w.	21
Jacksonville, Fla	31	11	14	19	n. 14 w.	21
Florida Peninsula.						
Jupiter, Fla	25	13	18	18	n.	12
Key West, Fla	42	1	31	4	n. 33 e.	49
Sand Key, Fla. †	18	1	17	3	n. 39 e.	22
Tampa, Fla	35	6	15	15	n.	29
Eastern Gulf States.						
Atlanta, Ga	22	14	17	20	n. 21 w.	8
Macon, Ga.†	16	4	7	10	n. 14 w.	12
Pensacola, Fla.†	18	4	10	4	n. 23 e.	15
Birmingham, Ala	14	7	12	5	n. 45 e.	10
Mobile, Ala	32	14	10	12	n. 6 w.	18
Montgomery, Ala	29	13	21	12	n. 29 e.	18
Meridian, Miss.†	15	6	9	8	n. 6 e.	9
Vicksburg, Miss	23	17	21	9	n. 63 e.	13
New Orleans, La	31	16	20	9	n. 36 e.	19
Western Gulf States.						
Shreveport, La	19	18	20	16	n. 76 e.	4
Fort Smith, Ark	18	7	30	17	n. 50 e.	17
Little Rock, Ark	23	12	19	22	n. 15 w.	11
Corpus Christi, Tex	24	18	28	2	n. 77 e.	27
Fort Worth, Tex	18	25	14	15	s. 8 w.	7
Galveston, Tex	22	24	19	8	s. 80 e.	11
Palestine, Tex	22	24	16	8	s. 76 e.	8
San Antonio, Tex	21	22	25	5	s. 87 e.	20
Taylor, Tex. †	12	11	4	8	n. 76 w.	4
Ohio Valley and Tennessee.						
Chattanooga, Tenn	26	13	14	19	n. 21 w.	14
Knoxville, Tenn	32	10	17	19	n. 5 w.	22
Memphis, Tenn	25	19	17	13	n. 34 e.	7
Nashville, Tenn	23	22	12	13	n. 45 w.	1
Lexington, Ky. †	9	12	8	9	s. 18 w.	3
Louisville, Ky	22	18	12	19	n. 60 w.	8
Evansville, Ind.†	13	6	9	8	n. 8 e.	7
Indianapolis, Ind	20	17	16	21	n. 59 w.	6
Cincinnati, Ohio	16	17	18	22	s. 76 w.	4
Columbus, Ohio	15	24	11	24	s. 55 w.	16
Pittsburg, Pa	26	13	7	29	n. 60 w.	26
Parkersburg, W. Va	18	24	9	21	s. 63 w.	13
Elkins, W. Va	23	12	4	29	n. 66 w.	27
Lower Lake Region.						
Buffalo, N. Y	10	19	10	32	s. 68 w.	24
Oswego, N. Y	13	31	6	23	s. 43 w.	25
Rochester, N. Y	8	25	4	37	s. 62 w.	37
Syracuse, N. Y	8	27	7	29	s. 49 w.	29
Erie, Pa	17	24	5	26	s. 72 w.	22
Cleveland, Ohio	9	34	12	20	s. 18 w.	25
Sandusky, Ohio †	5	14	1	15	s. 57 w.	17
Toledo, Ohio	10	27	7	29	s. 52 w.	28
Detroit, Mich	12	22	3	34	s. 72 w.	33
Upper Lake Region.						
Alpena, Mich	12	18	5	37	s. 79 w.	33
Escanaba, Mich	16	17	4	38	s. 88 w.	34
Grand Rapids, Mich	17	19	10	24	s. 82 w.	14
Houghton, Mich.†	12	5	6	12	n. 41 w.	9
Marquette, Mich	15	16	6	34	s. 88 w.	28
Port Huron, Mich	12	22	6	33	s. 70 w.	29
Sault Ste. Marie, Mich	18	17	18	22	n. 76 w.	4
Chicago, Ill	17	19	8	28	s. 84 w.	20
Milwaukee, Wis	18	16	3	33	n. 86 w.	30
Green Bay, Wis	13	26	5	30	s. 63 w.	28
Duluth, Minn	17	16	6	35	n. 88 w.	29
North Dakota.						
Moorhead, Minn	21	19	13	22	n. 77 w.	9
Bismarck, N. Dak	25	19	14	18	n. 34 w.	7
North Dakota—Continued.						
Williston, N. Dak	18	20	12	23	s. 80 w.	11
Upper Mississippi Valley.						
Minneapolis, Minn.*	9	12	6	12	s. 63 w.	7
St. Paul, Minn	20	19	15	24	n. 84 w.	9
La Crosse, Wis. †	14	10	3	7	n. 45 w.	6
Davenport, Iowa	18	16	15	24	n. 77 w.	9
Des Moines, Iowa	20	20	15	20	w.	5
Dubuque, Iowa	18	22	14	24	s. 68 w.	11
Keokuk, Iowa	18	20	17	21	s. 63 w.	4
Cairo, Ill	25	21	16	13	n. 37 e.	5
Springfield, Ill	18	20	14	21	s. 74 w.	7
Hannibal, Mo. †	12	6	5	11	n. 45 w.	8
St. Louis, Mo	15	20	23	18	s. 45 w.	7
Missouri Valley.						
Columbia, Mo. *	8	10	11	8	s. 56 e.	4
Kansas City, Mo	18	22	20	15	s. 51 e.	6
Springfield, Mo	21	23	18	16	s. 45 w.	3
Topeka, Kans.*	12	12	7	4	e.	3
Lincoln, Nebr	25	19	16	12	n. 34 e.	7
Omaha, Nebr	28	17	11	13	n. 10 w.	11
Valentine, Nebr	22	15	12	22	n. 55 w.	12
Sioux City, Iowa †	13	9	8	8	n.	4
Pierre, S. Dak	22	11	24	15	n. 39 e.	14
Huron, S. Dak	20	20	13	16	w.	3
Yankton, S. Dak. †	10	6	7	12	n. 51 w.	6
Northern Slope.						
Havre, Mont	13	12	14	34	n. 87 w.	20
Miles City, Mont	16	26	9	20	s. 48 w.	15
Helena, Mont	11	21	4	39	s. 74 w.	36
Kalispell, Mont	12	14	7	40	s. 87 w.	33
Rapid City, S. Dak	24	10	9	31	n. 58 w.	26
Cheyenne, Wyo	22	13	9	33	n. 69 w.	26
Lander, Wyo	13	27	16	17	s. 4 w.	14
North Platte, Nebr	18	19	11	24	s. 86 w.	13
Middle Slope.						
Denver, Colo	11	30	11	20	s. 25 w.	21
Pueblo, Colo	18	18	23	18	e.	5
Concordia, Kans	20	22	18	12	s. 72 e.	6
Dodge, Kans	22	18	18	17	n. 14 e.	4
Wichita, Kans	28	19	18	8	n. 48 e.	14
Oklahoma, Okla	29	23	9	9	n.	6
Southern Slope.						
Abilene, Tex	19	31	16	6	s. 40 e.	16
Amarillo, Tex	16	24	12	22	s. 51 w.	13
Southern Plateau.						
El Paso, Tex	21	5	12	37	n. 57 w.	30
Santa Fe, N. Mex	22	18	30	8	n. 80 e.	22
Flagstaff, Ariz	30	10	10	24	n. 35 w.	24
Phoenix, Ariz	12	2	30	23	n. 35 e.	12
Yuma, Ariz	35	7	20	4	n. 30 e.	32
Independence, Cal	19	17	12	28	n. 83 w.	16
Middle Plateau.						
Carson City, Nev	12	24	10	27	s. 55 w.	21
Winnemucca, Nev	22	16	21	15	n. 45 e.	8
Modena, Utah	8	14	14	37	s. 75 w.	24
Salt Lake City, Utah	13	24	24	16	s. 36 e.	14
Grand Junction, Colo	23	14	16	27	n. 51 w.	14
Northern Plateau.						
Baker City, Oreg	5	36	26	11	s. 26 e.	34
Boise, Idaho	16	21	21	16	s. 45 e.	7
Lewiston, Idaho †	2	6	14	12	s. 27 e.	4
Pocatello, Idaho	2	18	33	18	s. 43 e.	22
Spokane, Wash	17	21	23	8	s. 75 e.	16
Walla Walla, Wash	7	37	12	12	s.	30
North Pacific Coast Region.						
North Head, Wash	6	27	33	11	s. 46 e.	30
Port Crescent, Wash. *	2	15	11	11	s.	13
Seattle, Wash	9	29	31	6	s. 51 e.	32
Tacoma, Wash	11	38	9	17	s. 17 w.	28
Tatoosh Island, Wash	2	26	27	11	s. 34 e.	29
Portland, Oreg	12	25	21	20	s. 4 e.	13
Roseburg, Oreg	12	24	18	21	s. 14 w.	12
Middle Pacific Coast Region.						
Eureka, Cal	9	29	18	13	s. 14 e.	21
Mount Tamalpais, Cal	18	23	13	23	s. 63 w.	11
Red Bluff, Cal	22	21	21	8	n. 86 e.	13
Sacramento, Cal	15	28	24	10	s. 47 e.	19
San Francisco, Cal	16	17	10	26	s. 87 w.	16
Point Reyes Light, Cal. *	12	8	4	13	n. 66 w.	10
Southeast Farallon, Cal. *	11	10	2	14	n. 85 w.	12
South Pacific Coast Region.						
Fresno, Cal	22	20	17	18	n. 27 w.	2
Los Angeles, Cal	18	6	14	32	n. 56 w.	22
San Diego, Cal	34	5	19	19	n.	29
San Luis Obispo, Cal	32	13	1	16	n. 38 w.	24
West Indies.						
Basseterre, St. Kitts, W. I	.....	.....	.....	.....	.....	.....
Bridgetown, Barbados	.....	.....	.....	.....	.....	.....
Cienfuegos, Cuba	.....	.....	.....	.....	.....	.....
Colon, Colombia, S. A. †	.....	.....	.....	.....	.....	.....
Curaçoa, W. I	.....	.....	.....	.....	.....	.....
Grand Turk, W. I. †	9	3	22	3	n. 72 e.	20
Hamilton, Bermuda	20	19	12	19	n. 82 w.	7
Havana, Cuba †	9	5	20	3	n. 77 e.	18
Kingston, Jamaica	.....	.....	.....	.....	.....	.....
Port of Spain, Trinidad †	0	17	20	2	s. 47 e.	25
Puerto Principe, Cuba	.....	.....	.....	.....	.....	.....
Roseau, Dominica, W. I. †	13	7	13	6	n. 49 e.	9
San Juan, Porto Rico	9	31	26	9	s. 38 e.	28
Santiago de Cuba, Cuba	.....	.....	.....	.....	.....	.....
Santo Domingo, Santo Domingo	.....	.....	.....	.....	.....	.....

* From observations at 8 p. m. only. † From observations at 8 a. m. only.

TABLE IV.—*Thunderstorms and auroras, November, 1903.*

States.	No. of stations.		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Total. No.	Total. Days.	
Alabama	52	T.	1		1		2						3					2	3															12	6	T.
		A.																																0	0	A.
Arizona	56	T.																																0	0	T.
		A.																			1													1	1	A.
Arkansas	57	T.	3		1	5						1	1					3									1							15	7	T.
		A.																																0	0	A.
California	167	T.	1						1				1	1										3	10									17	6	T.
		A.																																0	0	A.
Colorado	81	T.																																0	0	T.
		A.																																0	0	A.
Connecticut	21	T.																																0	0	T.
		A.																																0	0	A.
Delaware	5	T.																	3															3	1	T.
		A.																																0	0	A.
Dist. of Columbia	4	T.																																0	0	T.
		A.																																0	0	A.
Florida	47	T.	2	1	4	9	1	8	1		1								1								1	3				1		33	12	T.
		A.																																0	0	A.
Georgia	55	T.	2	8	4	2	4				1		2	1				2	11	1														38	11	T.
		A.																																0	0	A.
Idaho	34	T.																																0	0	T.
		A.																																0	0	A.
Illinois	92	T.	2		1	3	1					7	19	1			1	13																48	9	T.
		A.													1					2														3	2	A.
Indiana	58	T.		2		4						1	24	1	1		2	26											1					62	9	T.
		A.																																0	0	A.
Indian Territory	11	T.			1	1																												2	2	T.
		A.																																0	0	A.
Iowa	149	T.	2	1	2	1				1			4				1																	12	7	T.
		A.																		6														6	1	A.
Kansas	77	T.	4	5				1				4	4		1																	1		20	7	T.
		A.																																0	0	A.
Kentucky	41	T.	2		2	1	1						10					12	1															29	7	T.
		A.															1			1		1												3	3	A.
Louisiana	46	T.				1	6												1								1							9	4	T.
		A.																																0	0	A.
Maine	19	T.	1															1	1															3	3	T.
		A.	1							1	3		1							1		1	3											11	7	A.
Maryland	43	T.																1	3															4	2	T.
		A.															1																	1	1	A.
Massachusetts	48	T.																1																1	1	T.
		A.	1	1											1					2							1							6	5	A.
Michigan	106	T.								1		1	18				10	6			1													37	6	T.
		A.	1	1			1		1												1													5	5	A.
Minnesota	67	T.																																0	0	T.
		A.	5	2							2	1								7			1											18	6	A.
Mississippi	44	T.	4		2		9	1				1	7					2	5															31	8	T.
		A.																																0	0	A.
Missouri	95	T.	36	6	4	7	1				3	12	19				6	15																109	10	T.
		A.								1										1														2	2	A.
Montana	40	T.														1																		1	1	T.
		A.	4	1															1	3	2		1											12	6	A.
Nebraska	142	T.	11	2	12	1																												26	4	T.
		A.																		3	1							1	1					6	4	A.
Nevada	40	T.												1																				1	1	T.
		A.																																0	0	A.
New Hampshire	19	T.																																0	0	T.
		A.									4									3		1	1											9	4	A.
New Jersey	51	T.					1											1	8															10	3	T.
		A.																																0	0	A.
New Mexico	31	T.																																0	0	T.
		A.																																0	0	A.
New York	99	T.														1		3																4	2	T.
		A.	1																															1	1	A.
North Carolina	56	T.		1	1	1	1					1	1					2	16															24	8	T.
		A.																																0	0	A.
North Dakota	48	T.																																0	0	T.
		A.	1				1	1	1			1						1	2	7	2	1	1											19	11	A.
Ohio	128	T.											23		1		11	59	10															104	5	T.
		A.	1								1																							2	2	A.
Oklahoma	23	T.	1		2	2																												5	3	T.
		A.																																0	0	A.
Oregon	74	T.	1			3	2	1	3		4	2			1	7					2	1	1											28	12	T.
		A.																																0	0	A.
Pennsylvania	91	T.															3	24	5															32	3	T.
		A.	1	1							1			1							1													5	5	A.
Rhode Island	7	T.																																0	0	T.
		A.																		2														2	1	A.
South Carolina	46	T.		8	2	5											1	1	8															25	6	T.
		A.																																0	0	A.
South Dakota	56	T.																																0	0	T.
		A.	2		1					1	1			1				2	2	9			2		1							1		23	11	A.
Tennessee	56	T.	8	4	5	3	1						10	2	1	1		14	15															64	11	T.
		A.																																0	0	A.
Texas	95	T.	2		3	8	3					2							2															20	6	T.
		A.																																0	0	A.
Utah	47	T.																																0	0	T.
		A.				1	1																											2	2	A.
Vermont	16	T.																																0	0	T.
		A.			1															3			1											5	3	A.
Virginia	50	T.											1				1	2	10															14	4	T.
		A.																																0	0	A.
Washington	64	T.				1				1	3				2					1		4	2											14	7	T.
		A.																																0	0	A.
West Virginia	43	T.													1	3		16	7	1														28	5	T.
		A.																																0	0	A.
Wisconsin	60	T.										1	3																					4	2	T.
		A.																		3				1										4	2	A.
Wyoming	31	T.																																0	0	T.
		A.																2	1															3	2	A.
Sums	2893	T.	83	38	47	58	33	11	5	3	12	33	150	7	8	13	36	206	110	3	3	5	3	3	10	....	3	3	1	....	....	2	....	889	....	T.
		A.	18	6	2	1	3	1	2	3	12	2	1	2	2	....	2	5	6	53	8	4	10	1	1	....	1	1	1	....	....	1	....	149	....	A.

TABLE V.—*Accumulated amounts of precipitation for each 5 minutes, for storms in which the rate of fall equaled or exceeded 0.25 in any 5 minutes, or 0.75 in 1 hour during November, 1903, at all stations furnished with self-registering gages.*

Stations.	Date.	Total duration.		Total amount of precipitation.	Excessive rate.		Amount before excessive began.	Depths of precipitation (in inches) during periods of time indicated.													
		From—	To—		Began—	Ended—		5 min.	10 min.	15 min.	20 min.	25 min.	30 min.	35 min.	40 min.	45 min.	50 min.	60 min.	80 min.	100 min.	120 min.
	1	2	3	4	5	6	7														
Albany, N. Y	5			0.52														0.12			
Alpena, Mich	11			0.51														*			
Amarillo, Tex †																					
Asheville, N. C	17			1.28														0.44			
Atlanta, Ga	3	11:54 a. m.	6:40 p. m.	1.54	1:07 p. m.	1:35 p. m.	0.37	0.18	0.29	0.44	0.65	0.73	0.78								
Atlantic City, N. J	5			0.44														0.28			
Augusta, Ga	2	4:27 p. m.	6:45 p. m.	2.34	5:03 p. m.	6:00 p. m.	0.05	0.06	0.15	0.34	0.45	0.66	1.06	1.38	1.75	2.00	2.19	2.24			
Baltimore, Md	4-5			0.30														0.17			
Binghamton, N. Y	16-17			1.65														0.23			
Birmingham, Ala	11			0.23														0.18			
Bismarck, N. Dak	24-25			0.12																	
Block Island, R. I	5			0.52														0.50			
Boise, Idaho	14			0.19														0.10			
Boston, Mass	16-17			0.99														0.17			
Buffalo, N. Y	16			0.75														0.30			
Cairo, Ill	1-2			0.76														0.35			
Charleston, S. C	17			0.42									0.40								
Charlotte, N. C	4			0.97														0.56			
Chattanooga, Tenn	17			1.40														0.63			
Chicago, Ill	28			0.14														*			
Cincinnati, Ohio	16			0.37														0.37			
Cleveland, Ohio	16			0.56									0.30								
Columbia, Mo	11			0.39														0.37			
Columbia, S. C	4			0.40														0.23			
Columbus, Ohio	15			0.59														0.36			
Concord, N. H	16-17			0.82														0.13			
Corpus Christi, Tex	3			0.40														0.20			
Davenport, Iowa	11			0.53														0.24			
Denver, Colo	16-17			0.04														*			
Des Moines, Iowa	2			0.25														0.10			
Detroit, Mich	15-16			0.66														0.39			
Dodge, Kans	3			0.29								0.26									
Dubuque, Iowa	11			0.69														0.28			
Duluth, Minn	22-23			0.45														*			
Eastport, Me	12			0.76														0.31			
Elkins, W. Va	16			0.52														0.25			
Erie, Pa	15-16			0.49														0.23			
Escanaba, Mich	12			0.38														0.18			
Evansville, Ind	4			0.78														0.55			
Fort Smith, Ark	3-4			0.54														0.32			
Fort Worth, Tex †																					
Galveston, Tex	17			0.03																	
Grand Junction, Colo	15			0.01																	
Grand Rapids, Mich	11			0.29														0.13			
Green Bay, Wis	11			0.51														*			
Harrisburg, Pa	16			0.30														0.17			
Hatteras, N. C	9-10			1.34														0.41			
Huron, S. Dak	24-25			0.17														*			
Indianapolis, Ind	2			0.33														0.33			
Jacksonville, Fla	4			1.18														0.73			
Jupiter, Fla	4-5	8:23 p. m.	2:20 a. m.	1.07	9:04 p. m.	9:58 p. m.	T.	0.18	0.35	0.46	0.47	0.48	0.48	0.48	0.50	0.55	0.77	0.88			
Kalispell, Mont	14			1.40														*			
Kansas City, Mo	10-11	8:50 p. m.	12:30 a. m.	1.14	10:12 p. m.	10:44 p. m.	0.34	0.13	0.19	0.27	0.33	0.47	0.55	0.61	0.64	0.67					
Key West, Fla	21			0.65														0.25			
Knoxville, Tenn	17	D. N.	11:15 a. m.	2.20	2:30 a. m.	3:10 a. m.	0.03	0.12	0.23	0.34	0.46	0.52	0.73	1.05	1.13	1.17					
La Crosse, Wis	11			0.02																	
Lewiston, Idaho	6-7			0.84														0.13			
Lexington, Ky	4			1.19														0.22			
Lincoln, Nebr	1			0.73														0.58			
Little Rock, Ark	4			0.36														0.28			
Los Angeles, Cal †																					
Louisville, Ky	1-2			1.27														0.23			
Lynchburg, Va	17			0.55														0.17			
Macon, Ga	2	8:10 a. m.	12:25 p. m.	1.26	10:35 a. m.	11:16 a. m.	0.22	0.08	0.12	0.23	0.42	0.59	0.73	0.85	0.91	0.94					
	17	2:18 p. m.	4:15 p. m.	0.75	3:20 p. m.	3:32 p. m.	0.01	0.16	0.51	0.70											
Memphis, Tenn	1	8:45 p. m.	10:30 p. m.	1.08	8:50 p. m.	9:25 p. m.	T.	0.08	0.19	0.25	0.39	0.61	0.81	0.90							
Meridian, Miss	3			0.16														0.12			
Milwaukee, Wis	11			1.02														0.42			
Montgomery, Ala	17			0.33										0.33							
Nantucket, Mass	17-18			1.55														0.66			
Nashville, Tenn	1	4:25 a. m.	8:50 a. m.	1.22	8:10 a. m.	8:37 a. m.	0.60	0.05	0.14	0.27	0.42	0.57	0.62								
	16	7:58 p. m.	9:25 p. m.	0.73	8:17 p. m.	8:35 p. m.	0.02	0.17	0.34	0.47	0.52	0.56									
New Haven, Conn	16			1.05														0.45			
New Orleans, La	17			0.11					0.11												
New York, N. Y	5			0.42														0.26			
Norfolk, Va	17-18	7:15 p. m.	8:35 a. m.	1.73	7:37 p. m.	8:40 p. m.	T.	0.05	0.14	0.20	0.24	0.29	0.35	0.44	0.49	0.54	0.66	0.81	0.94		
Northfield, Vt	5			0.16														0.07			
North Head, Wash	20			0.29														0.29			
Oklahoma, Okla	3-4			0.30														0.14			
Omaha, Nebr	1			0.25														0.15			
Palestine, Tex	25			0.01																	
Parkersburg, W. Va	16-17			1.34														0.29			
Pensacola, Fla	2	9:06 p. m.	11:30 p. m.	5.12	9:39 p. m.	10:29 p. m.	0.14	0.25	0.45	0.49	0.64	1.04	1.41	1.92	2.27	2.46	2.68				
					10:29 p. m.	11:20 p. m.		2.89	3.06	3.21	3.43	3.64	3.76	3.94	4.38	4.76	4.91	4.98			
Philadelphia, Pa	5			0.36														0.16			
Pittsburg, Pa	16-17			0.72														0.29			
Pocatello, Idaho	8			0.78														*			
Portland, Me	5			0.38														0.16			
Portland, Oreg	5-6			3.88														0.36			
Pueblo, Colo	16-17			0.10														*			
Raleigh, N. C	17-18			0.70														0.45			
Richmond, Va	17			0.97														0.47			
Rochester, N. Y	16			0.46														0.22			
Sacramento, Cal	14			0.85														0.28			
St. Louis, Mo	1			0.24														0.12			
St. Paul, Minn	12			0.15														0.05			
Salt Lake City, Utah	12-13			1.22														*			
San Antonio, Tex	17			T.																	
San Diego, Cal	15			T.																	
Sandusky, Ohio	16			0.60														0.38			
San Francisco, Cal	19-20			2.45														0.45			

TABLE V.—*Accumulated amounts of precipitation for each 5 minutes, etc.*—Continued.

Stations.	Date.	Total duration. From—	Total duration. To—	Total amount of precipitation.	Excessive rate. Began—	Excessive rate. Ended—	Amount before excessive began.	5 min.	10 min.	15 min.	20 min.	25 min.	30 min.	35 min.	40 min.	45 min.	50 min.	60 min.	80 min.	100 min.	120 min.
	1	2	3	4	5	6	7														
Savannah, Ga	4	1:56 p. m.	4:25 p. m.	0.81	2:40 p. m.	2:53 p. m.	0.04	0.20	0.43	0.54	0.56	0.58									
Scranton, Pa	16-17			1.15														0.14			
Seattle, Wash	5			1.02														0.22			
Shreveport, La	11			0.04														0.03			
Spokane, Wash	5-6			0.88														0.26			
Springfield, Ill	16			0.26														0.24			
Syracuse, N. Y	16			0.26														0.18			
Tampa, Fla	6	9:55 a. m.	12:45 p. m.	0.88	10:12 a. m.	10:34 a. m.	0.02	0.11	0.26	0.67	0.81	0.83									
Taylor, Tex.	4			0.32							0.18										
Toledo, Ohio	16			0.37					0.33												
Topeka, Kans	1-2			0.64														0.56			
Valentine, Nebr	13			0.02																	
Vicksburg, Miss	11			0.12														0.12			
Washington, D. C	4-5			0.35														0.19			
Wichita, Kans	1-2			0.38														0.16			
Wilmington, N. C	4-5			0.40														0.20			
Wytheville, Va	17			0.79														0.17			
Yankton, S. Dak	24			0.52														*			
Havana, Cuba	19-20	8:42 p. m.	10:20 a. m.	2.27	10:05 p. m.	10:35 p. m.	0.17	0.11	0.34	0.44	0.74	0.98	1.12	1.16							
San Juan, Porto Rico	29-30	9:50 p. m.	6:40 a. m.	1.31	1:25 a. m.	1:50 a. m.	0.42	0.00	0.29	0.44	0.55	0.64	0.68	0.71							

* Self register not working. † No precipitation during the month.

TABLE VI.—*Data furnished by the Canadian Meteorological Service, November, 1903.*

Stations.	Pressure, in inches. Actual, reduced to mean of 24 hours.	Pressure. Sea level, reduced to mean of 24 hours.	Pressure. Departure from normal.	Temperature. Mean.	Temperature. Departure from normal.	Temperature. Mean maximum.	Temperature. Mean minimum.	Precipitation. Total.	Precipitation. Departure from normal.	Precipitation. Depth of snow.
	Ins.	Ins.	Ins.	°	°	°	°	Ins.	Ins.	Ins.
St. Johns, N. F	29.76	29.90	—.04	41.2	+ 4.7	47.7	34.6	4.67	—0.90	0.0
Sydney, C. B. I	29.86	29.90	—.05	40.7	+ 3.6	48.1	33.4	6.13	+0.69	3.5
Halifax, N. S	29.79	29.90	—.11	41.2	+ 3.9	47.7	34.7	9.59	+3.93	3.7
Grand Manan, N. B	29.84	29.89	—.12	38.4	— 0.5	44.3	32.4	7.64	+2.02	2.5
Yarmouth, N. S	29.85	29.92	—.10	40.0	+ 0.1	46.2	33.8	6.19	+1.63	6.6
Charlottetown, P. E. I	29.84	29.88	—.08	37.3	+ 1.8	43.6	30.9	7.90	+3.93	6.8
Chatham, N. B	29.86	29.88	—.00	31.0	0.0	38.7	23.3	5.20	+1.45	25.4
Father Point, Que	29.88	29.90	—.06	30.3	+ 1.4	36.3	24.3	2.09	—1.02	16.5
Quebec, Que	29.63	29.97	—.05	29.4	+ 0.4	35.3	23.4	1.66	—2.10	9.7
Montreal, Que	29.79	30.01	—.02	32.2	+ 0.4	37.7	26.8	1.47	—2.27	5.4
Bissett, Ont	29.40	30.03	+.02	26.7	— 2.4	37.2	16.3	0.71	—1.87	6.9
Ottawa, Ont	29.66	30.00	—.02	31.2	— 0.5	37.1	25.4	0.69	—1.85	3.0
Kingston, Ont	29.71	30.03	—.01	34.3	— 0.7	41.0	27.6	1.41	—1.83	3.1
Toronto, Ont	29.66	30.05	+.01	35.0	— 0.6	42.2	27.8	1.24	—1.90	2.4
White River, Ont	28.64	30.00	+.02	21.3	+ 0.8	31.0	11.9	3.56	+1.71	11.8
Port Stanley, Ont	29.42	30.08	+.03	34.3	— 2.5	41.8	26.9	1.63	—1.74	0.8
Saugeen, Ont	29.30	30.03	+.01	34.8	— 0.2	41.9	27.6	2.04	—1.66	14.5
Parry Sound, Ont	29.25	29.96	—.05	31.9	— 0.2	39.3	24.4	1.69	—2.68	11.8
Port Arthur, Ont	29.30	30.03	+.03	26.0	+ 2.0	33.7	18.4	0.35	—0.98	0.8
Winnipeg, Man										
Minnedosa, Man	28.20	30.10	+.06	20.7	+ 3.4	39.9	11.5	1.57	+0.57	15.0
Qu'Appelle, Assin	27.72	30.04	+.04	22.2	+ 3.4	30.4	13.9	1.10	+0.21	11.0
Medicine Hat, Assin	27.70	30.04	+.04	25.1	— 2.3	34.5	15.7	0.45	—0.47	4.5
Swift Current, Assin	27.42	30.09	+.07	23.6	+ 0.4	31.7	15.4	0.42	—0.27	4.2
Calgary, Alberta	26.37	30.05	+.07	21.1	— 4.7	30.8	11.4	0.60	—0.28	6.0
Banff, Alberta	25.32	30.08	+.12	22.7	— 3.1	29.2	16.1	2.00	—0.27	15.3
Edmonton, Alberta	27.62	29.98	+.01	22.9	0.0	31.7	14.2	0.86	+0.28	7.1
Prince Albert, Sask	28.42	30.03	.00	19.9	+ 4.5	27.3	12.4	1.16	+0.33	11.6
Battleford, Sask	28.28	30.10	+.08	19.8	+ 3.5	28.0	11.6	0.79	+0.21	7.5
Kamloops, B. C										
Victoria, B. C	29.82	29.92	—.07	44.5	+ 1.3	47.9	41.1	6.00	—0.97	7.7
Barkerville, B. C										
Hamilton, Bermuda	29.88	30.04	—.01	68.3	— 0.4	72.9	63.6	5.03	+0.65	

TABLE VII.—*Heights of rivers referred to zeros of gages, November, 1903.*

Stations.	Distance to mouth of river.	Danger line on gage.	Highest water. Height.	Highest water. Date.	Lowest water. Height.	Lowest water. Date.	Mean stage.	Monthly range.
Mississippi River.	Miles.	Feet.	Feet.		Feet.		Feet.	Feet.
St. Paul, Minn	1,954	14	7.1	1	3.0	22, 23	5.1	4.1
Red Wing, Minn	1,914	14	7.3	1	3.3	30	4.7	4.0
Reeds Landing, Minn	1,884	12	6.0	1	2.5	24-30	3.9	3.5
La Crosse, Wis	1,819	12	8.1	1	3.8	29, 30	5.5	4.3
Prairiedu Chien, Wis[1]	1,759	18	9.6	1	3.7	26	6.3	5.9
Dubuque, Iowa	1,699	15	10.6	1	2.8	30	6.7	7.8
Leclaire, Iowa	1,609	10	7.1	1	0.7	30	4.2	6.4
Davenport, Iowa	1,593	15	9.6	1	2.5	30	6.1	7.1
Muscatine, Iowa	1,562	16	11.0	1	3.0	30	7.1	8.0
Galland, Iowa	1,472	8	5.7	1	1.9	30	3.6	3.8
Keokuk, Iowa	1,463	15	10.0	1	2.4	30	6.1	7.6
Hannibal, Mo.	1,402	13	11.7	1	4.4	30	7.9	7.3
Grafton, Ill	1,306	23	13.0	1	6.1	30	9.5	6.9
St. Louis, Mo	1,264	30	15.4	1	6.4	30	11.9	9.0
Chester, Ill	1,189	30	12.7	1	6.1	30	10.2	6.6
New Madrid, Mo	1,003	34	12.7	1, 2	8.9	29	10.8	3.8
Memphis, Tenn	843	33	9.3	1, 2	5.7	30	7.6	3.6
Helena, Ark	767	42	14.3	1	9.2	30	11.7	5.1
Arkansas City, Ark	635	42	16.2	1	10.1	28-30	13.3	6.1
Greenville, Miss	595	42	12.9	1	8.1	30	10.8	4.8
Vicksburg, Miss	474	45	14.5	1	7.9	30	11.5	6.6
Natchez, Miss	373	46	15.8	1	10.4	29, 30	13.2	5.4
Baton Rouge, La	240	35	9.2	1	5.5	30	7.5	3.7
Donaldsonville, La	188	28	6.2	1	3.7	30	5.2	2.5
New Orleans, La	108	16	5.3	1	3.0	30	4.4	2.3
James River.								
Huron, S. Dak[2]	98	17	0.7	15	0.5	1-6, 9, 11-14	0.5	0.2
Missouri River.	Miles.	Feet.	Feet.		Feet.		Feet.	Feet.
Bismarck, N. Dak		25	1.5	1-5, 16	0.0	21	0.9	1.5
Pierre, S. Dak[3]	210	9	2.4	12, 13	2.0	18	2.2	0.4
Sioux City, Iowa[2]	2,504	10	5.6	4	4.9	17	5.4	0.7
Omaha, Nebr	2,285	12	6.8	1	4.4	19	5.8	2.4
St. Joseph, Mo.	1,309	14	3.5	6, 7	0.1	25, 27, 28	1.8	3.4
Kansas City, Mo.	1,114	14	10.1	7	6.4	24-26, 29, 30	8.2	3.7
Boonville, Mo.	784	19	9.2	6, 8	5.7	29, 30	7.8	3.5
Hermann, Mo.	669	18	9.8	7	5.6	28-30	7.7	4.2
Illinois River.								
Peoria, Ill.	135	14	10.2	1	8.9	21-24, 28-30	9.4	1.3
Youghiogheny River.								
Confluence, Pa.	59	10	2.0	17, 18	—0.4	3-5	0.4	2.4
West Newton, Pa.	15	23	3.1	18	0.2	2-5	0.8	2.9
Allegheny River.								
Warren, Pa.	177	14	6.2	18	0.6	13-16	2.0	5.6
Oil City, Pa	123	13	7.5	18	1.1	5, 6, 11-16	2.4	6.4
Parker, Pa.	73	20	10.0	18	0.9	4, 5, 14-16	2.5	9.1
Freeport, Pa	29	20	15.7	18	1.5	4	4.4	14.2
Clarion River.								
Clarion, Pa.	32	10	10.8	17	0.0	12	2.1	10.8
Monongahela River.								
Weston, W. Va.	161	18	—0.1	18	—1.6	10, 11, 15, 16	—1.2	1.5
Fairmont, W. Va.	119	25	15.8	19	7.2	17	13.0	8.6
Greensboro, Pa	81	18	8.4	20	5.4	17	6.3	3.0
Lock No. 4, Pa	40	28	9.5	20, 21	6.1	1-4	7.3	3.4
Conemaugh River.								
Johnstown, Pa.	64	7	4.2	17	0.4	13-15	1.5	3.8

TABLE VII.—*Heights of rivers referred to zeros of gages*—Continued.

Stations.	Distance to mouth of river.	Danger line on gage.	Highest water. Height.	Highest water. Date.	Lowest water. Height.	Lowest water. Date.	Mean stage.	Monthly range.
Red Bank Creek.	Miles.	Feet.	Feet.		Feet.		Feet.	Feet.
Brookville, Pa.	35	8	6.5	17	0.2	9-16, 25-30	0.7	6.3
Beaver River.								
Ellwood Junction, Pa[4]	10	14	3.8	18	0.7	12-16	1.8	3.1
Great Kanawha, River.								
Charleston, W. Va.	58	30	7.2	21-23	6.5	1-4	6.9	0.7
Little Kanawha River.								
Glenville, W. Va	103	20	3.0	18	-2.2	4, 5, 10-12	-1.0	5.2
New River.								
Radford, Va	155	14	0.0	6-9, 18-20	-0.5	3	-0.2	0.5
Hinton, W. Va.	95	14	1.6	7	1.2	1-5, 12, 13, 17, 18, 28-30	1.3	0.4
Cheat River.								
Rowlesburg, W. Va.[5]	36	14	4.0	18	0.6	4.5	1.6	3.4
Ohio River.								
Pittsburg, Pa	966	22	12.2	18	3.5	26	6.1	8.7
Davis Island Dam, Pa.	960	25	11.8	18	2.9	1, 2, 4, 5, 7, 13-16	4.8	8.9
Beaver Dam, Pa	925	27	16.5	19	3.1	7	6.1	13.4
Wheeling, W. Va.	875	36	16.3	19	2.9	6, 8, 15, 16	5.7	13.4
Parkersburg, W. Va.	785	36	14.9	20	3.3	16	5.8	11.6
Point Pleasant, W. Va.	705	39	13.7	21	1.8	9	4.3	11.9
Huntington, W. Va.	660	50	16.8	22	4.3	7-9	7.0	12.5
Catlettsburg, Ky.	651	50	16.2	22	2.1	7-9	5.1	14.1
Portsmouth, Ohio	612	50	16.2	22	3.3	7-10, 14	6.2	12.9
Cincinnati, Ohio.	499	50	16.5	24	4.5	11-16	7.3	12.0
Madison, Ind	413	46	13.6	25	4.6	12-15	6.6	9.0
Louisville, Ky	367	28	7.5	26	3.0	5. 6, 11-13	4.0	4.5
Evansville, Ind	184	35	10.0	28	2.3	18	4.1	7.7
Paducah, Ky.	47	40	6.0	30	1.9	19, 20	2.7	4.1
Cairo, Ill.	1,073	45	15.4	2	10.9	29	13.2	4.5
Muskingum River.								
Zanesville, Ohio	70	20	8.9	19	7.3	1-6, 10-16	7.5	1.6
Scioto River.								
Columbus, Ohio[4]	110	17	2.9	24-27	2.2	1-8	2.5	0.7
Miami River.								
Dayton, Ohio	77	18	2.0	18	0.7	1-4	1.0	1.3
Wabash River.								
Mount Carmel, Ill.	50	15	0.9	8-13	0.6	5, 6, 21-24, 28	0.7	0.3
Licking River.								
Falmouth, Ky.	30	25	2.0	19	0.2	1-4	0.7	1.8
Kentucky River.								
High Bridge, Ky.	117	17	10.2	18, 20-22	8.7	10-16	9.2	1.5
Frankfort, Ky.	65	31	6.7	18, 21-23	5.2	14-16	5.9	1.5
Clinch River.								
Speers Ferry, Va.	156	20	0.2	18	-1.1	1, 10, 11	-0.6	1.3
Clinton, Tenn.	52	25	7.5	18	2.3	1, 11, 12	3.2	5.2
Holston River.								
Bluff City, Tenn.	170	15	2.0	17	0.0	3, 4, 10, 11, 28	0.3	2.0
Rogersville, Tenn.	103	14	2.6	19	1.2	2, 4, 5, 16	1.5	1.4
French Broad River.								
Asheville, N. C.	144	14	0.1	18	-0.7	1-3, 10-16, 28-30	-0.5	0.8
Leadvale, Tenn.	70	15	1.4	19	-1.2	3, 13	-0.5	2.6
Hiwassee River.								
Charleston, Tenn	18	22	5.2	18	0.4	29, 30	1.1	4.8
Tennessee River.								
Knoxville, Tenn.	635	29	2.5	19	0.0	1.2	0.6	2.5
Kingston, Tenn.	556	25	4.2	18	0.8	1.2	1.3	3.4
Chattanooga, Tenn.	452	33	6.6	19	0.8	1	2.0	5.8
Bridgeport, Ala.	402	24	4.0	20	0.0	1	1.0	4.0
Florence, Ala.	255	16	3.5	22	-0.4	1.2	0.6	3.9
Riverton, Ala.	225	25	3.8	23	-1.7	1	0.0	5.5
Johnsonville, Tenn.	95	24	4.3	24, 25	0.0	1.2	1.6	4.3
Cumberland River.								
Burnside, Ky.	516	50	4.8	19	1.0	1.2	2.2	3.8
Carthage, Tenn.	305	40	5.0	19	0.0	1	1.8	5.0
Nashville, Tenn	189	40	6.7	20	0.7	1	3.1	6.0
Clarksville, Tenn	126	42	8.0	21	0.5	1	4.0	7.5
Arkansas River.								
Wichita, Kans.	832	10	2.0	4	0.1	19, 20	0.8	1.9
Webbers Falls, Ind. T.	465	23	10.0	6, 7	2.8	3	4.6	7.2
Fort Smith, Ark.	403	22	10.3	7	2.3	1.2	4.7	8.0
Dardanelle, Ark	256	21	9.8	9	1.6	3.4	4.0	8.2
Little Rock, Ark.	176	23	10.1	10	3.3	2.3	5.2	6.8
White River.								
Newport, Ark.	150	26	1.2	8-12	0.2	29, 30	0.9	1.0
Yazoo River.								
Yazoo City, Miss.	80	25	-1.9	17, 18	-2.5	1-11	-2.3	0.6
Red River.								
Arthur City, Tex.	638	27	8.7	2	4.5	21-30	5.3	4.2
Fulton, Ark.	515	28	10.8	6	4.2	29, 30	5.9	6.6
Shreveport, La.	327	29	2.6	10	-1.9	29, 30	-0.5	4.5
Alexandria, La.	118	33	2.1	15	-0.6	30	0.6	.72
Ouachita River.								
Camden, Ark.	304	39	4.4	1	3.8	29, 30	4.1	0.6
Monroe, La.	122	40	2.8	1	1.4	26-30	1.6	1.4
Atchafalaya River.								
Melville, La.	100	31	14.0	1	8.5	30	11.4	5.5
Penobscot River.								
Mattawamkeag, Me.[6]	......	......	9.4	18-20	8.3	2	8.9	1.1
Montague, Me	......	......	2.6	15, 16	1.3	6, 7	1.8	1.3
Kennebec River.								
Winslow, Me	......	......	4.1	23	1.0	16	2.9	3.1
Merrimac River.								
Franklin Junction, N. H.	......	......	4.6	19	3.8	9, 29, 30	4.2	0.8
Concord, N. H[6]	......	......	1.4	19, 20	0.9	16, 17	1.1	0.5
Manchester, N. H	......	......	3.8	1, 22	2.0	28	3.1	1.8
Connecticut River.								
Wells River, Vt.[7]	......	......	25.3	8.9	24.3	1.2	24.8	1.0
White River Junction, Vt	......	......	4.7	2-7, 9-13, 16	4.3	22	4.6	0.4
Bellows Falls, Vt	......	......	2.8	8	0.3	28	1.7	2.5
Holyoke, Mass.	......	......	3.7	22	-0.9	27	1.7	4.6
Hartford, Conn	......	......	5.0	19	1.6	8	2.9	3.4
Housatonic River.								
Gaylordsville, Conn	......	......	6.0	18-20	-4.2	13, 16	4.7	1.8
Passaic River.								
Chatham, N. J	69	......	3.1	18	2.4	15-17	2.6	0.7
Pompton River.								
Pompton Plains, N. J[6]	6	......	4.9	18	4.2	15, 16	4.4	0.7
Susquehanna River.								
Binghamton, N. Y.	306	16	6.9	18	2.3	15, 16	3.1	4.6
Towanda, Pa.	262	16	8.5	18	1.5	15, 16	2.7	7.0
Wilkesbarre, Pa	183	17	14.0	19	4.5	16	6.5	9.5
Harrisburg, Pa	69	17	8.7	19	2.3	14-17	3.5	6.4
West Branch Susquehanna.								
Lockhaven, Pa[4]	65	12	5.2	18	-0.4	15, 16	0.8	5.6
Williamsport, Pa	39	20	12.0	18	1.2	14, 15	3.0	10.8
Juniata River.								
Huntingdon, Pa.[8]	90	24	4.3	17	3.1	1-11	3.4	1.2
Shenandoah River.								
Riverton, Va	58	22	0.1	1, 2	-0.5	13-30	-0.3	0.6
Potomac River.								
Cumberland, Md.	290	8	1.5	1, 2, 5, 6	1.2	12-15, 23-25	1.3	0.3
Harpers Ferry, W. Va.	172	18	0.4	23	-0.3	4-17	-0.2	0.7
James River.								
Lynchburg, Va	260	18	0.9	6	0.3	21-30	0.4	0.6
Richmond, Va.	111	12	0.5	9	-0.5	29	0.2	1.0
Dan River.								
Danville, Va	55	8	1.2	6	-0.1	1-4, 16, 17	0.1	1.3
Roanoke River.								
Clarksville, Va	196	12	4.5	18	2.7	1-3	3.3	1.8
Weldon, N. C.	129	30	11.4	20	8.9	1, 3	9.4	2.5
Cape Fear River.								
Fayetteville, N. C	112	38	5.3	8	2.1	18	2.9	3.2
Edisto River.								
Edisto, S. C	75	6	3.6	21-23	2.9	3, 4, 14	3.1	0.7
Pedee River.								
Cheraw, S. C	149	27	5.0	6	1.7	17	2.4	3.3
Black River.								
Kingstree, S. C.	52	12	6.0	1	4.0	10-15	4.5	2.0
Lynch Creek.								
Effingham, S. C.	35	12	4.6	20, 21	3.0	4-7, 13	3.7	1.6
Santee River.								
St. Stephens, S. C.	97	12	6.3	10	1.5	1, 2	3.0	4.8
Congaree River.								
Columbia, S. C.	37	15	1.7	7	-0.1	16-18, 28-30	0.4	1.8
Wateree River.								
Camden, S. C.	45	24	12.0	6	6.0	28-30	7.0	6.0
Waccamaw River.								
Conway, S. C.	40	7	2.6	11, 12	1.0	19	1.9	1.6
Savannah River.								
Calhoun Falls, S. C.	347	15	2.7	20	2.0	27-30	2.2	0.7
Augusta, Ga.	268	32	9.3	5, 6	6.5	1	7.6	2.8
Broad River.								
Carlton, Ga.	30	11	3.1	4, 6	2.2	23-30	2.4	0.9
Flint River.								
Albany, Ga.	80	20	7.5	7	0.8	1, 2	3.8	6.7
Chattahoochee River.								
Oakdale, Ga	305	18	3.0	6	0.7	2	1.4	2.3
Westpoint, Ga	239	20	3.5	5	2.0	1	2.5	1.5
Eufaula, Ala.	90	40	3.5	7	1.0	1, 2	2.3	2.5
Ocmulgee River.								
Macon, Ga.	125	18	4.1	6	2.2	1	2.8	1.9
Abbeville, Ga.	50	11	6.4	8, 9	1.9	1, 2	3.8	4.5
Oconee River.								
Dublin, Ga	79	20	3.8	6	0.3	1, 2	1.3	3.5
Coosa River.								
Rome, Ga.	271	30	2.0	6, 7	0.7	1, 2	1.2	1.3
Gadsden, Ga.	144	22	1.2	8	-0.3	3	0.1	1.5
Alabama River.								
Montgomery, Ala.	265	35	1.4	10, 11	0.3	1	0.8	1.1
Selma, Ala	212	35	1.1	12	-0.2	1, 2	0.6	1.3
Tombigbee River.								
Columbus, Miss	303	33	-1.4	7, 8, 13	-3.2	1, 18	-2.3	1.8
Demopolis, Ala.	155	35	1.5	5	-2.4	1	-0.9	3.9
Black Warrior River.								
Tuscaloosa, Ala.	90	43	5.6	3	4.7	23-30	4.9	0.9
Sabine River.								
Logansport, La.	180	25	5.6	14	3.2	8.9	4.1	2.4
Orange, Tex.	10	7	0.9	1-5	0.4	26-30	0.6	0.5
Neches River.								
Rockland, Tex	110	20	0.7	8-10	0.3	5, 23-30	0.4	0.4
Beaumont, Tex[9]	40	10	......	......	......	......	......	......
Trinity River.								
Dallas, Tex.	330	25	10.2	2	2.0	26-30	3.2	8.2
Riverside, Tex.	100	40	4.2	8	0.6	29, 30	1.7	3.6
Liberty, Tex	42	25	6.7	15	3.8	30	5.1	2.9
Brazos River.								
Kopperl, Tex	369	21	1.0	16, 17	-1.0	15	0.0	2.0
Waco, Tex.	301	22	3.9	8	2.5	30	3.2	1.4
Hempstead, Tex	215	40	1.8	8	-0.5	30	0.5	2.3
Booth, Tex	76	39	4.0	1-16	2.4	30	3.5	1.6
Colorado River.								
Ballinger, Tex.	400	21	1.8	4	1.2	29, 30	1.4	0.6
Austin, Tex.	214	18	1.7	7-10	1.3	30	1.5	0.4
Columbus, Tex.	100	24	7.6	5	5.6	26-30	6.3	2.0
Red River of the North.								
Moorhead, Minn[8]	418	26	8.6	25, 26	8.0	16-20	8.1	0.6
Columbia River.								
Umatilla, Oreg.	270	25	5.6	25	4.6	22	5.2	1.0
The Dalles, Oreg.	166	40	8.0	11	6.4	23	7.3	1.6
Willamette River.								
Albany, Oreg	118	20	14.5	23	1.0	1	7.3	13.5
Portland, Oreg.	12	15	9.2	13, 15, 23, 24	2.8	1	6.9	6.4
Sacramento River.								
Red Bluff, Cal.	265	23	24.5	22	0.0	1, 2	7.5	24.5
Sacramento, Cal.	64	29	20.5	22	7.3	1, 2	14.1	13.2

[1] Frozen for 4 days. [2] Frozen for 13 days. [3] Frozen for 12 days. [4] Frozen for 3 days. [5] Frozen for 2 days. [6] Frozen for 5 days. [7] Frozen for 10 days. [8] Frozen for 4 days. [9] Data incorrect.

HAWAIIAN CLIMATOLOGICAL DATA.

By R. C. LYDECKER, Territorial Meteorologist.

Rainfall data for November, 1903.

Stations.	Elevation.	Amount.	Stations.	Elevation.	Amount.
HAWAII.					
HILO, e. and ne.	*Feet.*	*Inches.*	MAUI—Cont'd.	*Feet.*	*Inches.*
Waiakea	50	14.06	Haleakala Ranch	2,000	5.18
Hilo (town)	100	15.69	Wailuku, ne	250	2.35
Puueo	85	15.69	LANAI.		
Kaumana	1,250	24.04	Keomuku	10	0.09
Pepeekeo	100	14.26	OAHU.		
Hakalau	200	14.59	Punahou (W. B.), sw	47	2.26
Honohina	300	19.48	Kulaokahua (Castle), sw	50	1.91
Puuohua	1,050	24.84	Makiki Reservoir	120	3.14
Laupahoehoe	500	17.82	U. S. Naval Station, sw	6	1.99
Ookala	400	13.15	Kapiolani Park, sw	10	0.65
HAMAKUA, ne.			College Hills	175	2.44
Kukaiau	250	11.61	Manoa (Woodlawn Dairy), c.	285	11.31
Paauilo	300	10.71	Manoa (Rhodes Gardens)	360	14.72
Paauhau	300	12.24	Insane Asylum	30	2.15
Honokaa (Mill)	425	12.95	School street (Bishop), sw	......	....
Honokaa (Meinicke)	1,100	18.72	Kamehameha School	75	....
Kukuihaele	700	13.25	Kalihi-Uka, sw	485	....
KOHALA, n.			Nuuanu (W. W. Hall), sw	50	4.95
Awini Ranch	1,100	14.68	Nuuanu (Wyllie street)	250	....
Niulii	200	6.87	Nuuanu (Elec. Station), sw	405	7.96
Kohala (Mission)	521	6.79	Nuuanu (Luakaha), c	850	18.49
Kohala (Sugar Co.)	270	7.07	U. S. Experiment Station	350	....
Hawi, Mill	700	6.68	Kaliula	1,150	7.99
Puakea Ranch	600	4.82	Laniakea (Nahuina)	1,150	....
Puuhue Ranch	1,847	2.11	Tantalus Heights (Frear)	1,360	10.97
Waimea	2,720	4.55	Waimanalo, ne	25	3.76
KONA, w.			Maunawili, ne	300	6.90
Huehue	2,000	1.59	Kaneohe	100	3.56
Holualoa	1,350	2.51	Ahuimanu, ne	350	8.36
Kaukahoku Leheula	3,500	3.27	Kahuku, n	25	....
Kainaliu	1,470	4.13	Waialua	37	....
Kealakekua	1,580	3.24	Wahiawa	900	....
Napoopoo	25	2.35	Ewa Plantation, s	60	2.17
Hoopuloa	1,650	....	U. S. Magnetic Station	45	....
Hoopuloa	2,300	....	Waipahu	200	0.90
Puuwaawaa Ranch	2,700	1.63	Moanalua	15	2.76
Huehue	......	....	Pacific Heights	700	....
KAU, se.			KAUAI.		
Kahuku Ranch	1,680	4.06	Lihue (Grove Farm), e	200	1.99
Honuapo	15	2.74	Lihue (Molokoa), e	300	2.54
Naalehu	650	2.54	Lihue (Kukaua), e	1,000	5.31
Hilea	310	3.40	Kealia, e.	15	....
Pahala	850	4.15	Kilauea (Plantation), ne	325	2.52
Moaula	1,700	....	Hanalei, n	10	....
Volcano House	4,000	9.85	Waioli	10	....
PUNA, e.			Haena	15	....
Olaa, Mountain View (Russel)	1,690	....	Waiawa	32	0.26
Olaa (Plantation)	......	....	Eleele	150	0.57
Kapoho	110	10.28	Wahiawa (Mountain)	3,000	....
Pahoa	600	14.20	McBryde (Residence)	850	2.64
MAUI.			Lawai (Gov. Road)	450	....
Lahaina	40	....	Lawai, w	225	3.02
Waiopae Ranch	700	....	Lawai, e	800	2.82
Kaupo (Mokulau), s	285	5.23	Koloa	100	1.77
Kipahulu, s	308	7.20	*Delayed October reports.*		
Hana	......	....	Ewa Plantation	60	1.76
Nahiku, ne	850	27.22	Hoopuloa	1,650	4.70
Nahiku	1,600	....	Pahala	850	1.25
Haiku, n	700	7.67	Kealia	15	3.05
Kula (Erehwon), n	4,500	1.00	U. S. Magnetic Station	45	1.13
Kula (Waiakoa), n	2,700	0.70	Kaukahoku Leheule	3,500	3.11
Puuomalei, n	1,400	....	Kainaliu	1,470	3.13
Paia	180	2.83	Paia	180	3.49

NOTE.—The letters n, s, e, w, and c show the exposure of the station relative to the winds.

GENERAL SUMMARY FOR NOVEMBER, 1903.

Honolulu.—Temperature mean for the month, 73.6°; normal, 73.9°; average daily maximum, 79.0°; average daily minimum, 69.2°; mean daily range, 9.8°; greatest daily range, 15° (10th, 19th, and 27th); least daily range, 6° (12th and 21st); highest temperature, 82° (10th); lowest temperature, 63° (26th and 27th).

Barometer average, 29.990; normal, 29.957; highest, 30.10 (21st and 22d); lowest, 29.85 (27th and 28th); greatest 24-hour change, that is from any given hour of one day to the same hour on the next, .09 (15–16th and 20th–21st); lows passed this point, 11th to 14th and 26th to 28th, inclusive; highs, 1st to 9th, inclusive, 17th, 19th, and 21st to 24th, inclusive.

Relative humidity average, 72.8 per cent; normal, 75.5 per cent; mean dew-point, 63.7°; normal, 65.6°; mean absolute moisture, 6.49 grains per cubic foot; normal, 6.93 grains.

Rainfall, 2.24 inches; normal, 5.13 inches; rain record days, 16; normal, 17; greatest rainfall in one day, 1.50 (from 9 a. m. 15th to 9 a. m. 16th); total at Luakaha, 18.49; normal, 10.16; at Kapiolani Park, 0.65; normal, 4.05.

The artesian well water level remained nearly stationary, rising but .04 of a foot, from 33.30 to 33.34 feet above mean sea level. This is doubtless due to the small amount of rainfall during October and November. The average November rise is about .5 of a foot. November 30, 1902, it stood at 33.90. The average daily mean sea level for the month was 9.99 feet, the assumed annual mean being 10.00 feet above datum; for November, 1902, it was 10.13.

Trade wind days, 25, (two of nne.); normal, 17; average force of wind during daylight, Beaufort scale, 1.3; average cloudiness, tenths of sky, 3.5; normal, 4.6.

Approximate percentages of district rainfall as compared with normal: Hawaii, Hilo district, 152 per cent; Hamakua, 215; Kohala, 155; Waimea, 148; Kona, 68; Kau, 56; Puna, 112; island of Maui, 52, excepting Haleakala Ranch, 103; island of Oahu, 60 per cent, excepting Luakaha, 186; island Kauai, 26 per cent.

The heaviest 24-hour rainfalls were at Kaumana, 9.02 inches (15th); Puuohua, 8.63 inches (15th), and Honokaa, 8.15 inches (22d), all on Hawaii.

Meteorological Observations at Honolulu, November, 1903.

The station is at 21° 18′ N., 157° 50′ W. It is the Hawaiian Weather Bureau station Punahou. (See fig. 2, No. 1, in the MONTHLY WEATHER REVIEW for July, 1902, page 365.) Hawaiian standard time is 10h 30m slow of Greenwich time. Honolulu local mean time is 10h 31m slow of Greenwich.

The pressure is corrected for temperature and reduced to sea level, and the gravity correction, —0.06, has been applied.

The average direction and force of the wind and the average cloudiness for the whole day are given unless they have varied more than usual, in which case the extremes are given. The scale of wind force is 0 to 12, or Beaufort scale. Two directions of wind, or values of wind force, or amounts of cloudiness, connected by a dash, indicate change from one to the other.

Rainfall for twenty-four hours is measured at 9 a. m. local, or 7.31 p. m., Greenwich time.

The rain gage, 8 inches in diameter, is 1 foot above ground. Thermometer, 9 feet above ground. Ground is 43 feet and the barometer 50 feet above sea level.

Date.	Pressure at sea level.	Temperature.		During twenty-four hours preceding 1 p. m. Greenwich time, or 2:30 a. m. Honolulu time.									Total rainfall at 9 a. m., local time.
				Temperature.		Means.		Wind.		Average cloudiness.	Sea-level pressures.		
		Dry bulb.	Wet bulb.	Maximum.	Minimum.	Dew-point.	Relative humidity.	Prevailing direction.	Force.		Maximum.	Minimum.	
	*	†	†			‡	‡		§				
1	30.02	73	66	80	69	63.5	71	nne.	1	5	30.06	29.98	0.03
2	30.01	73	67.5	79	72	63.5	69	nne.-ne.	1–3	1	30.05	29.98	0.11
3	30.00	70	67.5	80	70	64.7	72	ne.	3–0	1–8	30.04	29.94	0.00
4	30.02	72	65.5	76	69	65.5	83	ne.	2–0	4	30.04	29.95	0.11
5	30.04	73	67	80	68	62.7	67	ne.	2–0	2	30.07	29.98	0.03
6	30.05	74	67.5	80	72	64.0	68	ne.	1	1–3	30.07	30.00	0.00
7	30.01	75	67.5	80	69	65.7	72	ne.	2	1–4	30.07	29.99	0.00
8	30.05	74	70	80	73	63.0	68	ne.	1–3	1–7–4	30.06	29.98	0.12
9	30.04	75	67.5	80	73	67.3	77	ene.	2–4	4–7	30.07	30.00	0.02
10	30.03	68	66	81	74	64.0	66	ne.	3–0	1–9–2	30.06	29.98	0.01
11	30.03	75	67	82	67	65.5	73	ne.	1–0	1–3	30.03	29.95	0.03
12	30.03	75	66.5	80	72	62.7	65	ne.	2–3	1–3	30.01	29.91	0.04
13	29.93	73	67	80	74	61.7	62	ne.	2	1–4	30.01	29.89	0.00
14	29.90	70	68	81	71	63.0	65	ne.	1–2	1	29.95	29.88	T.
15	29.92	75	71.5	79	70	67.3	80	ne.-ene.	1	3–7	29.95	29.88	0.05
16	29.99	75	69	81	73	70.3	84	ene.	1–0	5–10	30.02	29.92	0.02
17	30.00	71	67.5	79	72	66.3	73	ne.	2–0	2–5	30.05	29.98	1.50
18	30.00	71	63	77	70	60.5	67	nne.	1–3	4–1	30.06	29.96	0.10
19	30.02	66	63	78	68	59.7	66	ne.	1–0	1	30.02	29.92	T.
20	29.99	64	62	79	64	61.3	71	ne.	1–0	3	30.05	29.95	0.00
21	30.00	72	65	78	64	62.5	76	nne.	1–0	5	30.01	29.96	T.
22	30.06	70	64	76	70	61.7	70	ne.	3–5	4–2	30.10	30.00	0.00
23	30.06	72	64	77	69	60.0	67	ne.	4–2	2	30.10	30.02	0.00
24	30.00	67	64.5	77	70	60.7	67	ne.	1–2	4–7	30.08	29.97	T.
25	29.99	57	64	78	67	63.3	77	ne.	1–0	2–6	30.04	29.94	0.02
26	30.00	63	61	79	66	62.0	75	sw.	1–0	1–4	30.03	29.95	0.00
27	29.93	65	63	77	63	62.0	80	w.-sw.	1–0	3–6	30.02	29.90	T.
28	29.88	66	65	78	63	63.7	82	ssw.	1–0	3–7–2	29.94	29.85	0.00
29	29.96	70	69	78	65	66.0	83	sw.	1–0	0–6	29.95	29.85	0.01
30	30.01	70	67	79	69	68.0	87	wsw.	1–0	4–8	30.04	29.94	0.04
31	......	......	......	......	......	......	......	......	......	......	......	......	......
Sums	......	......	......	......	......	......	......	......	......	3.5	......	......	2.24
Means	29.999	70.8	66.1	79.0	69.2	63.7	72.8	....	1.3	–1.1	30.035	29.947	......
Departure	+.033	......	......	......	......	–1.9	–2.7	......	......	......	......	......	–2.89

Mean temperature for the month of November, 1903, $(6+2+9) \div 3 = 73.6°$; normal is 73.9°. Mean pressure for the month of November, 1903, $(9+3) \div 2 = 29.990$; normal is 29.957.

* This pressure is as recorded at 1 p. m., Greenwich time. † These temperatures are observed at 6 a. m., local, or 4.31 p. m., Greenwich time. ‡ These values are the means of $(6+9+2+9) \div 4$. § Beaufort scale.

Maximum thermometer set at 9 p. m. and minimum at 2 p. m., local time.

The heaviest monthly rainfall reported was at Nahiku (850 elevation), Maui, 27.22 inches.

Temperature table for November, 1903.

Stations.	Elevation.	Mean max.	Mean min.	Cor. av'ge.	Highest.	Lowest.
	Feet.	°	°	°	°	°
Hilo	50	80.1	66.4	72.6	85	63
Pepeekeo	100	77.6	68.5	72.4	82	66
Kohala	521	76.2	66.0	70.4	81	62
Naalehu	1,903					
Waimea	2,730	73.4	59.2	65.6	80	54
Volcano House	4,000	71.9	53.0	61.8	80	48
Waiakoa	2,700	78.0	56.3	66.5	87	51
Keomuku	10	80.3	73.1	76.0		
W. R. Castle	50	78.6	69.7	73.5	82	62
Ewa Plantation	60	81.5	65.3	72.7	84	60

Kohala, dew-point, 65.7°; relative humidity, 81.3 per cent.

Ewa plantation, dew-point, 61.6°; relative humidity, 67.2 per cent; barometer average, 29.96.

The month closed with continued volcanic activity, that of Mauna Loa's summit crater, Mokuaweoweo, was reported at the end of the month as being about the same as when first visited in October. The crater of Halemumau in Kilauea, was discovered in eruption at 2:30 a. m. of the 25th, and activity has since continued. The lava lake at the end of the month was reported as being 300 by 125 feet in size and not more than 650 feet from the crater's summit. This crater is 1.95 miles wide and 2.93 miles long, containing an area of 4.14 square miles or 2650 acres.

There have been no earthquakes reported to this office, but a newspaper report gives one in the Kona and Kau districts on the 12th, followed by increased activity of Mokuaweoweo, and the steamer *Mauna Loa* reports a disturbance of the sea while the vessel was at anchor off Punaluu, Hawaii, on the 17th. The sea suddenly became churned up and disturbed to such an extent as to capsize one of the ship's boats lying alongside, throwing its occupants into the water, where, though they were natives, they maintained themselves with difficulty, and the ship itself was swung around from its former position. This disturbance is reported as lasting ten minutes. Later in the day a huge black cloud was seen to belch from the summit crater, followed by the usual column of white smoke and steam. High seas in the channels and heavy surf along the windward coasts have been the rule. Tidal waves were reported from Pelekunu, Molokai; Kahului and Honokohau, Maui, on the 29th. At the latter place one wave rose to a height of 30 feet as measured by the mark left by the sea on the pali, doing considerable damage. From Koholalele, Hawaii, comes a report of heavy seas, lasting some hours, which swept clean over the top of a 40-foot crane at the landing and carried enormous boulders some distance inland. On this same date a portion of the railroad track along the northern part of Oahu was washed away by high seas and the tide gage in the harbor of Honolulu recorded evidence of an unusual agitation. Whether the cause of these latter disturbances was local volcanic activity or the result of seismic disturbances at or around the Aleutian Islands, or unusually heavy weather in the North Pacific, is problematical, with the weight of evidence in favor of seismic origin.

Thunder at Honolulu on the 15th during the heavy showers of the afternoon of that date. This was the only rain to speak of for this district during the month, 1.50 inches falling at the Weather Bureau between 1 and 5 p. m. of a total of 2.24 inches for the month. Bright afterglows on several occasions and a 44-degree lunar halo on the evening of the 26th.

The rainfall throughout the group, with the exceptions of the northern and eastern exposures of the island of Hawaii, was considerably below the November normal, due to the unusual absence of southerly wind for this period, the small precipitation at southerly exposures being especially marked. The barometer average for the past five months has been slightly above the normal, a condition likely to be followed by a winter of moderate rainfall.

Reports from other stations: Hilo and Pepeekeo, Hawaii, report a brilliant meteor on the evening of the 28th, passing from the south to a little east of north. Pepeekeo, wind north to east throughout the month, average force 1.4; dew six mornings; heavy surf, with the exception of a few days; snow on mountains 17th and a little still visible at the end of the month; reflection and smoke from volcano at intervals. Kohala, Hawaii, trade winds 1st to 26th, inclusive, variable balance of month. Waimea, Hawaii, fresh and strong northeast winds 1st to 18th, inclusive, light trades thereafter; reflection from volcano very bright last ten days; snow on mountains 15th and still visible on Mauna Kea at the end of the month; considerable cloudiness, and bright morning and afterglows throughout. Extremely high surf at Hilo 4th to 8th, inclusive.

MEXICAN CLIMATOLOGICAL DATA.

By Señor MANUEL E. PASTRANA, Director of the Central Meteorologic-Magnetic Observatory.

November, 1903.

Stations.	Altitude.	Mean barometer.*	Temperature.			Relative humidity.	Precipitation.	Prevailing direction.	
			Max.	Min.	Mean.			Wind.	Cloud.
	Feet.	*Inches.*	*° F.*	*° F.*	*° F.*	%	*Ins.*		
Chihuahua	4,684								
Guadalajara (Obs. del. Est.)	5,186	24.94	80.6	46.4	63.1	61	0.00	nw.	
Guana'uato	6,640								
Leon (Guanajuato)	5,906	24.28	79.0	37.8	59.2	56	T.	ne.	
Mazatlan	25	29.91	83.8	67.1	77.0	75	0.00	nw.	
Merida	50								
Mexico (Obs. Cent.)	7,472	23.08	76.6	38.3	55.6	55	0.04	ne.	ne.
Mexico (E. N. Agric.)	7,442								
Monterey (Semiuario)	1,626								
Morelia (Seminario)	6,401								
Pachuca	7,959								
Puebla (Col. Cath.)	7,108	23.39	76.8	34.9	55.2	65	0.41	ene.	
Puebla (Col. d Est.)	7,118	23.35	78.4	33.4	55.8	60	0.17	e.	
Parral		24.59	79.9	30.6	55.0		0.00	sw.	
Salina Cruz	492	29.85	91.6	66.2	80.1	62	0.00	ne.	
Vera Cruz		29.97	84.9	59.0	73.6	81	1.58		
Zacatecas	8,015	22.56	77.4	34.5	55.4	53	0.07	e.	
Zapotlan	5,078								

*The monthly barometric means are reduced to the international standard of gravity.

CLIMATOLOGICAL DATA FOR JAMAICA.

Through the kindness of Mr. H. H. Cousins, chemist to the government of Jamaica and now in charge of the meteorological service of that island, we have received the following table in advance of the regular monthly weather report for Jamaica:

Comparative table of rainfall for November, 1903.

[Based upon the average stations only.]

Divisions.	Relative area.	Number of stations.	Rainfall.	
			1903.	Average.
	Per cent.		*Inches.*	*Inches.*
Northeastern division	25	24	8.94	11.19
Northern division	22	53	4.43	5.83
West-central division	26	23	6.27	5.68
Southern division	27	32	3.49	4.25
Means	100	213	5.78	6.74

The rainfall for November was therefore below the average for the whole island. The greatest rainfall, 25.89 inches, occurred at Moore Town, in the northeastern division, while 0.54 inch was recorded at the Public Works office, Kingston.

The temperature inside Savoy House on the morning of the 29th was 59°; on the 30th, 61°, and on December 1, 67°. At Brandon Hill, Montego Bay, the lowest temperature was 56.2°, at 6 a. m. on November 29. The same low temperature occurred on February 10, 1886. At Spring Valley, Green Island, the thermometer on the morning of the 29th registered 58°, and it never went above 66° for the day—very cold.

XXXI—114.

• Barkerville

Chart I. Tracks of Centers of High Areas. November, 1903.

Chart I. Tracks of Centers of High Areas. November, 1903.

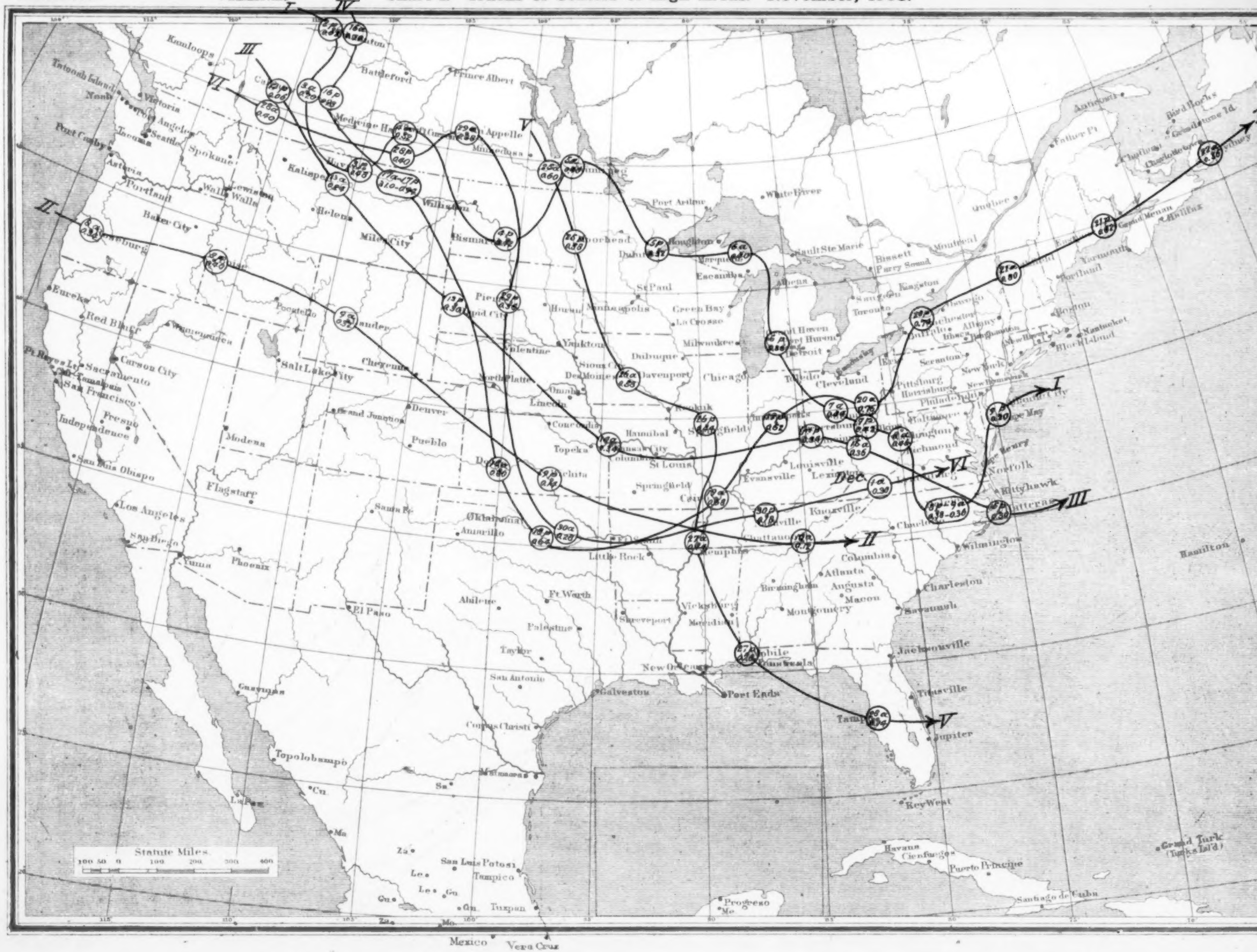


Chart II. Tracks of Centers of Low Areas. November, 1903.

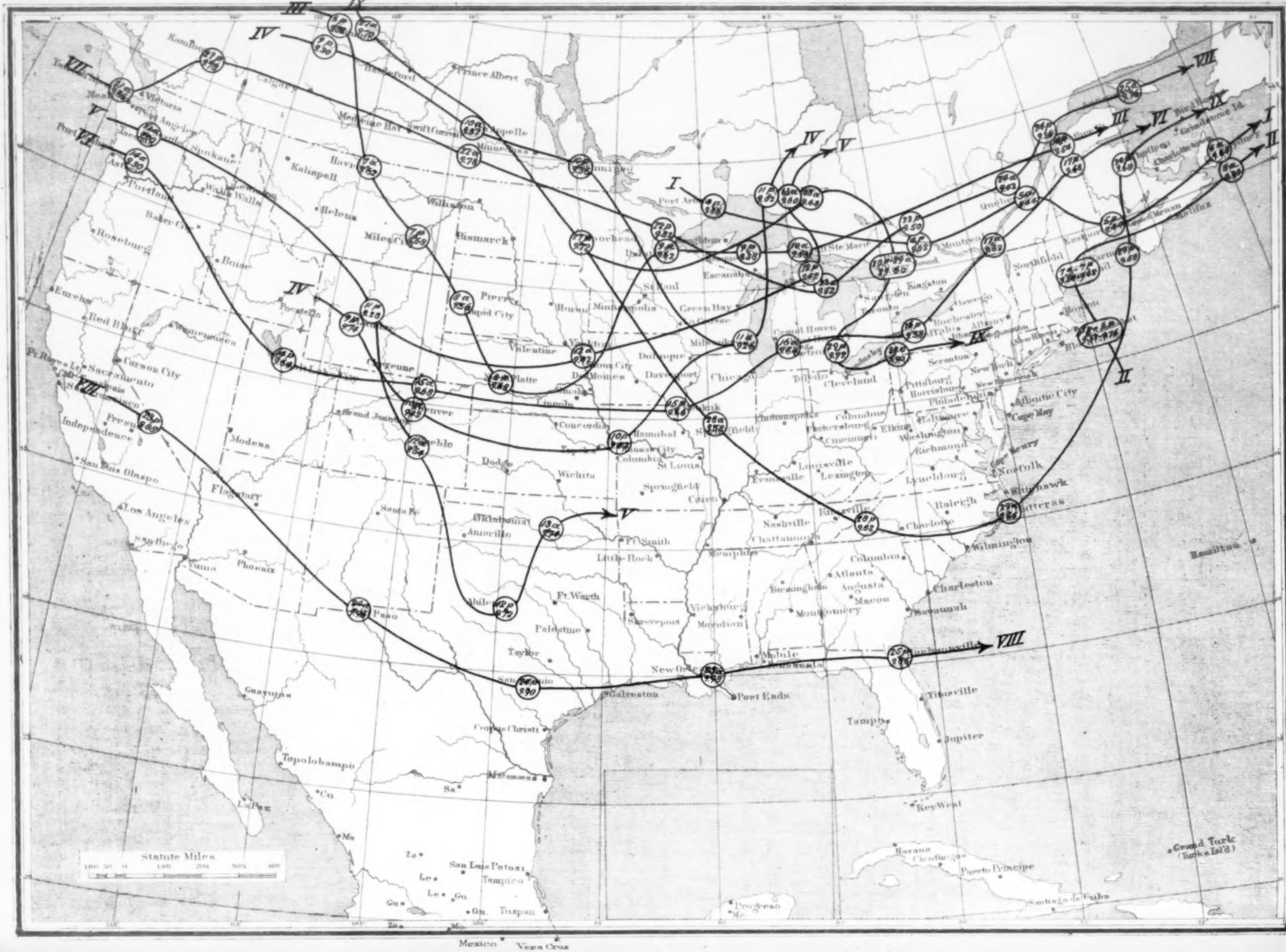


Chart III. Total Precipitation. November, 1903.

Chart III. Total Precipitation. November, 1903.

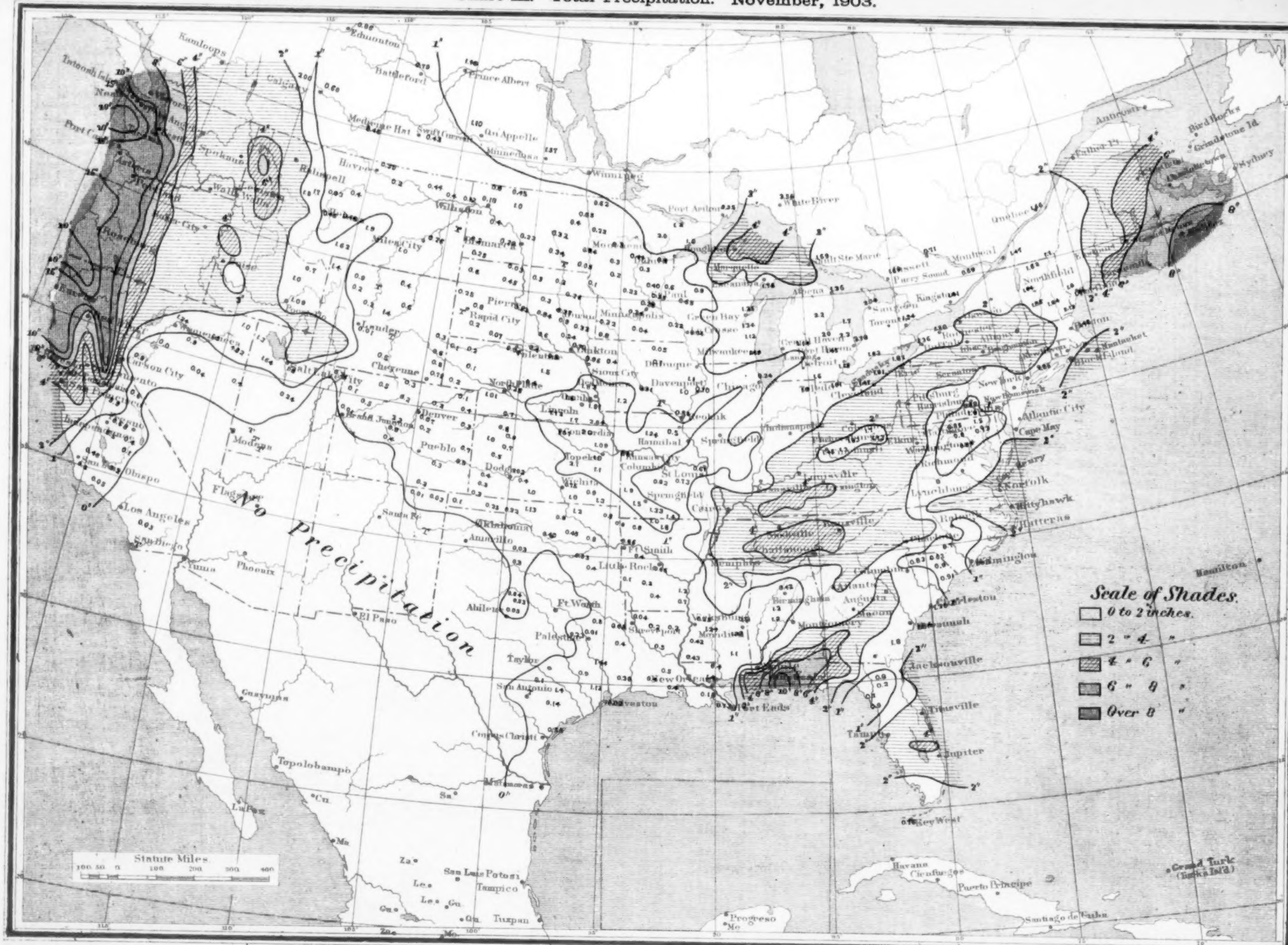


Chart IV. Sea-Level Pressure and Temperature; Resultant Surface Winds. November, 1903.

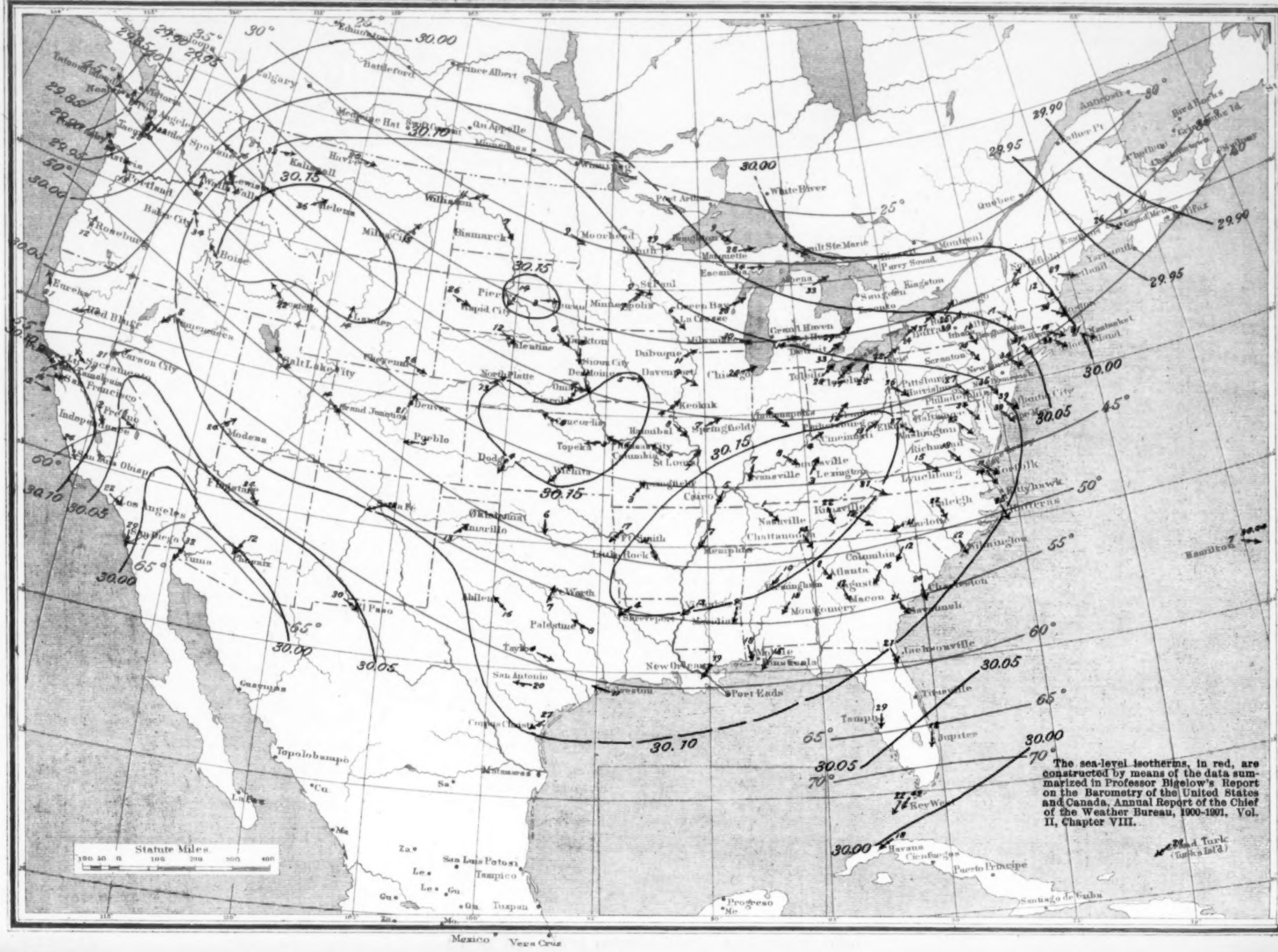


Chart V. Hydrographs for Seven Principal Rivers of the United States. November, 1903.

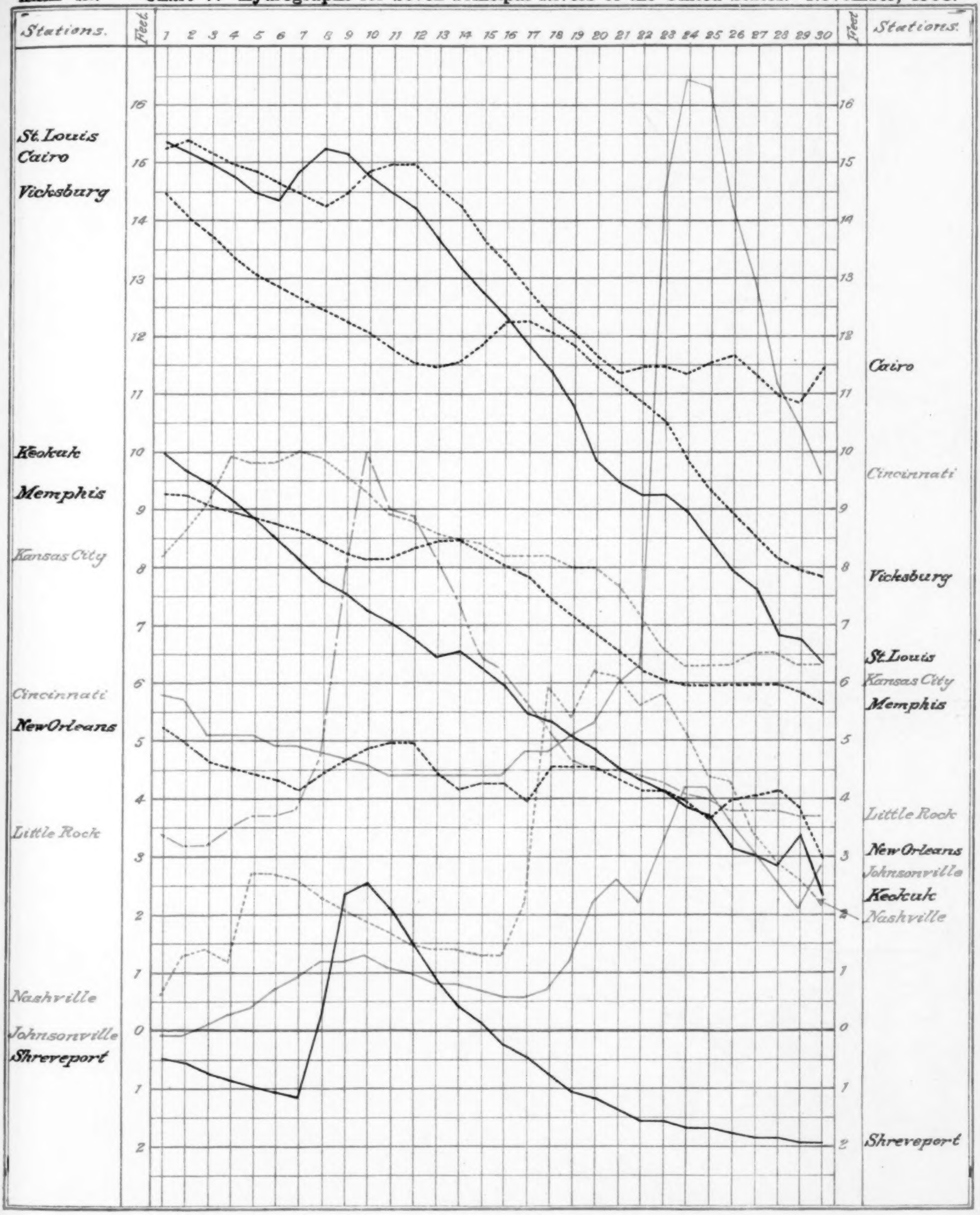


Chart VI. Surface Temperatures; Maximum, Minimum, and Mean. November, 1903.

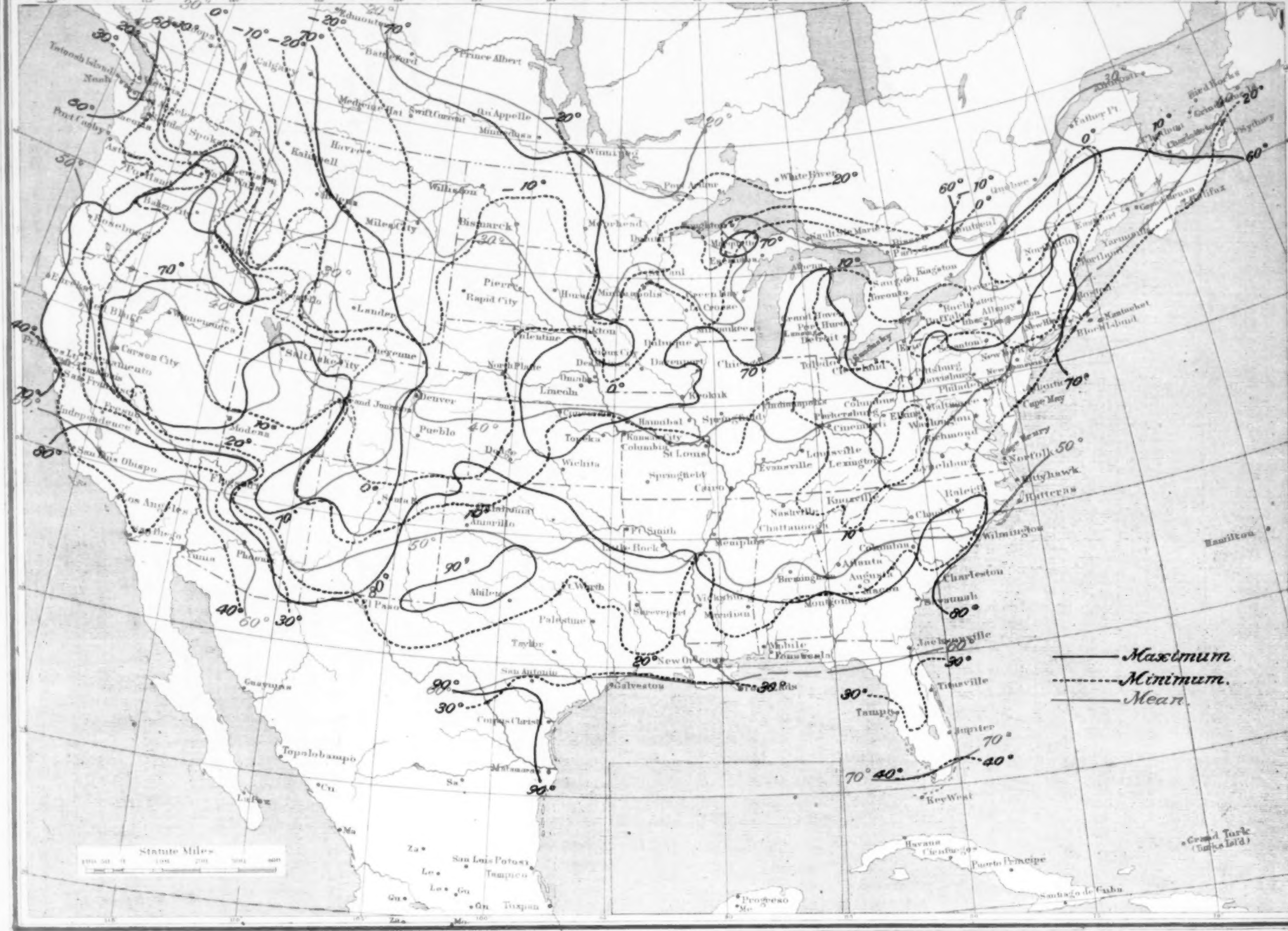
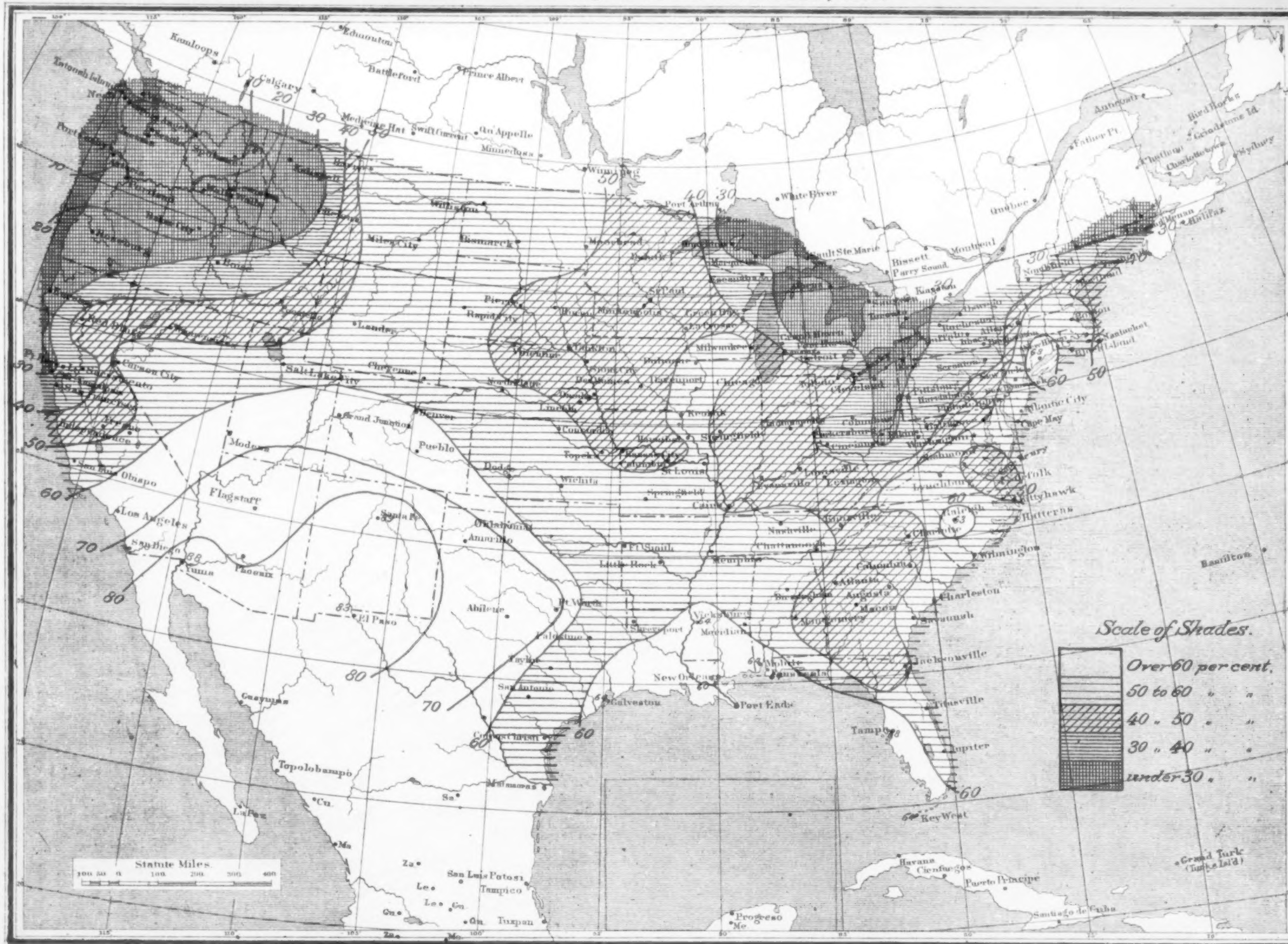


Chart VII. Percentage of Sunshine. November, 1903.

Chart VII. Percentage of Sunshine. November, 1903.



• Barkerville

Chart VIII. Isobars and Isotherms at 10,000 feet. November, 1903.

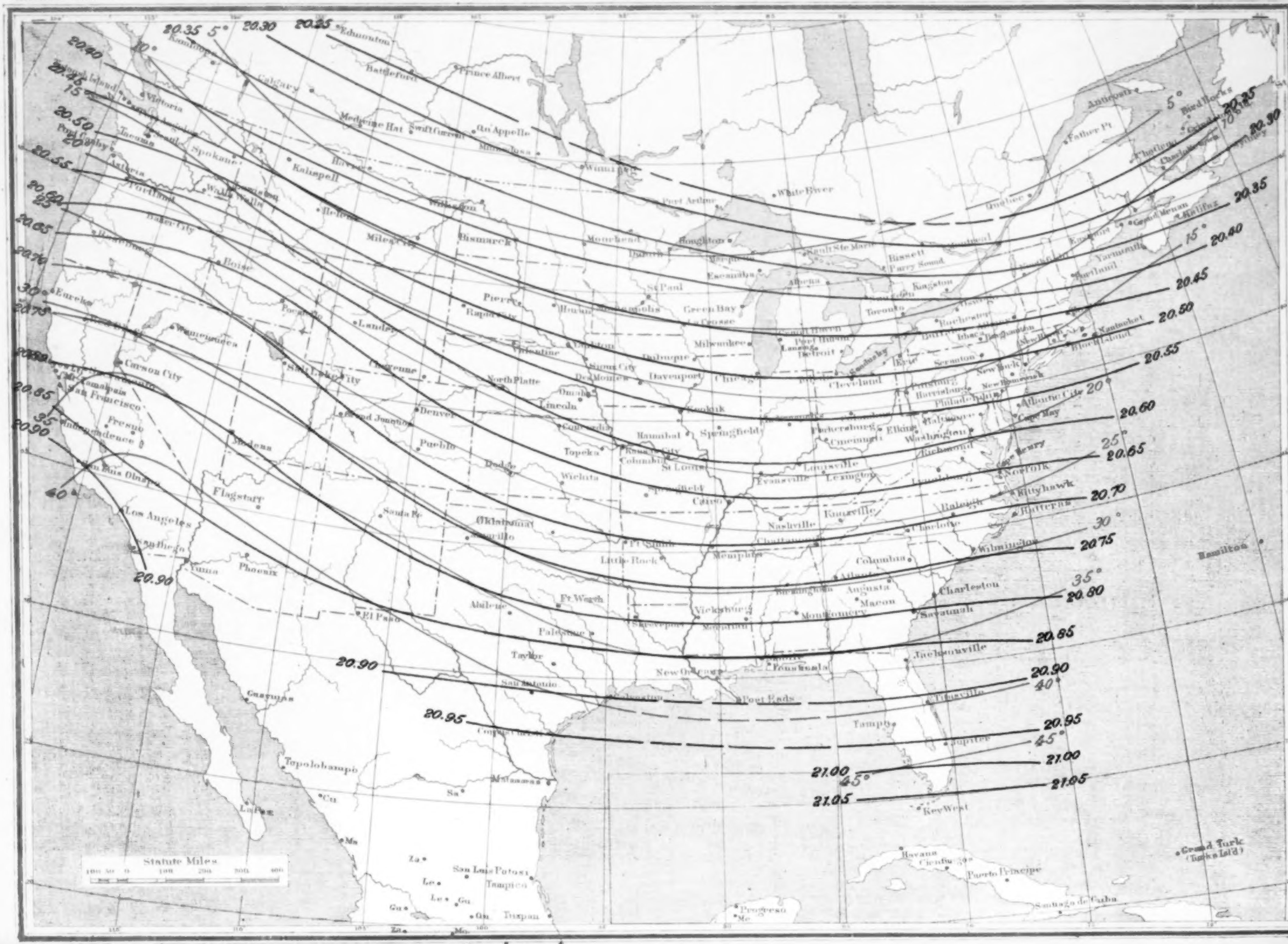


Chart IX. Isobars and Isotherms at 3,500 feet. November, 1903.

• Barkerville

Chart IX. Isobars and Isotherms at 3,500 feet. November, 1903.

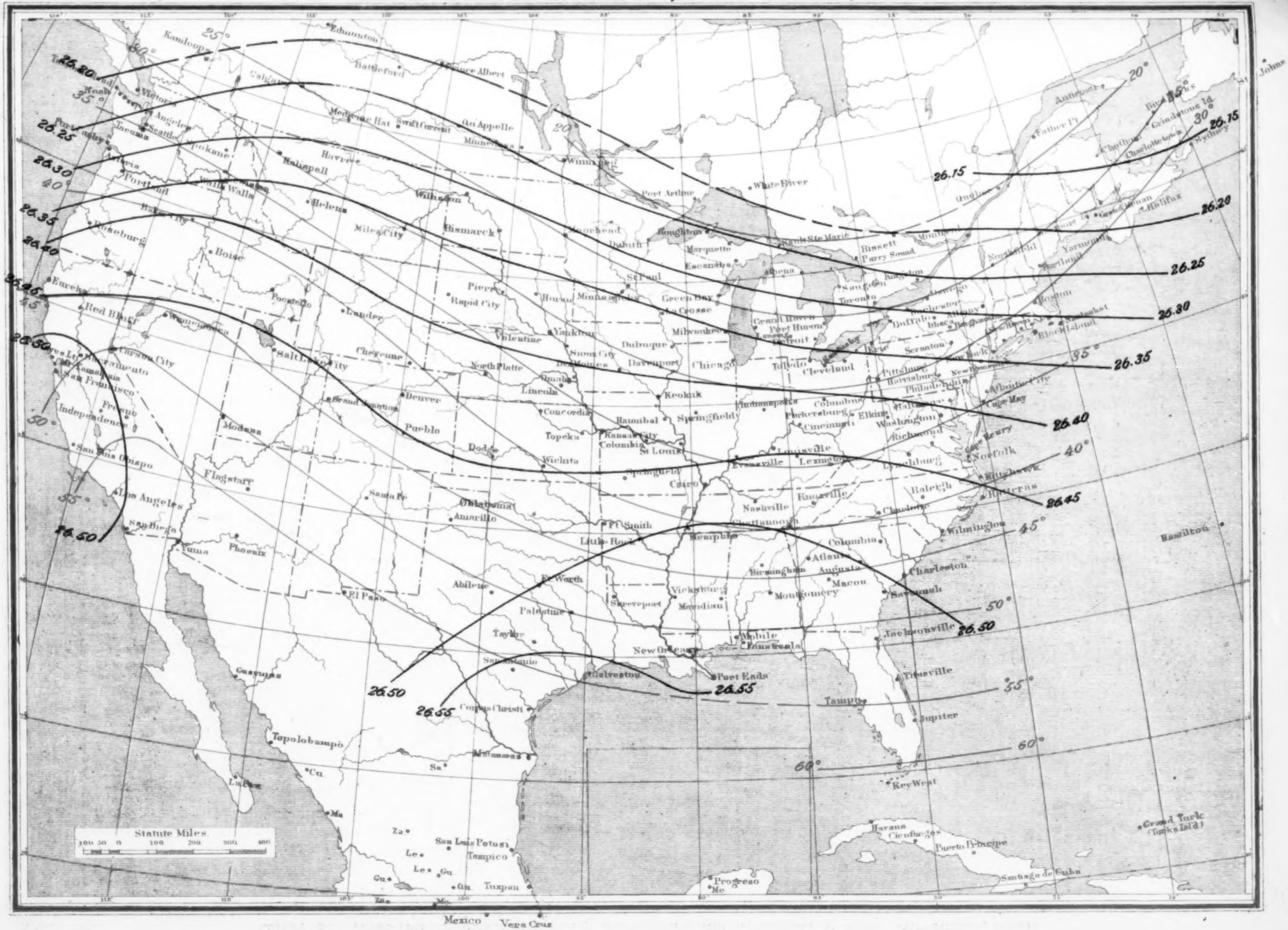
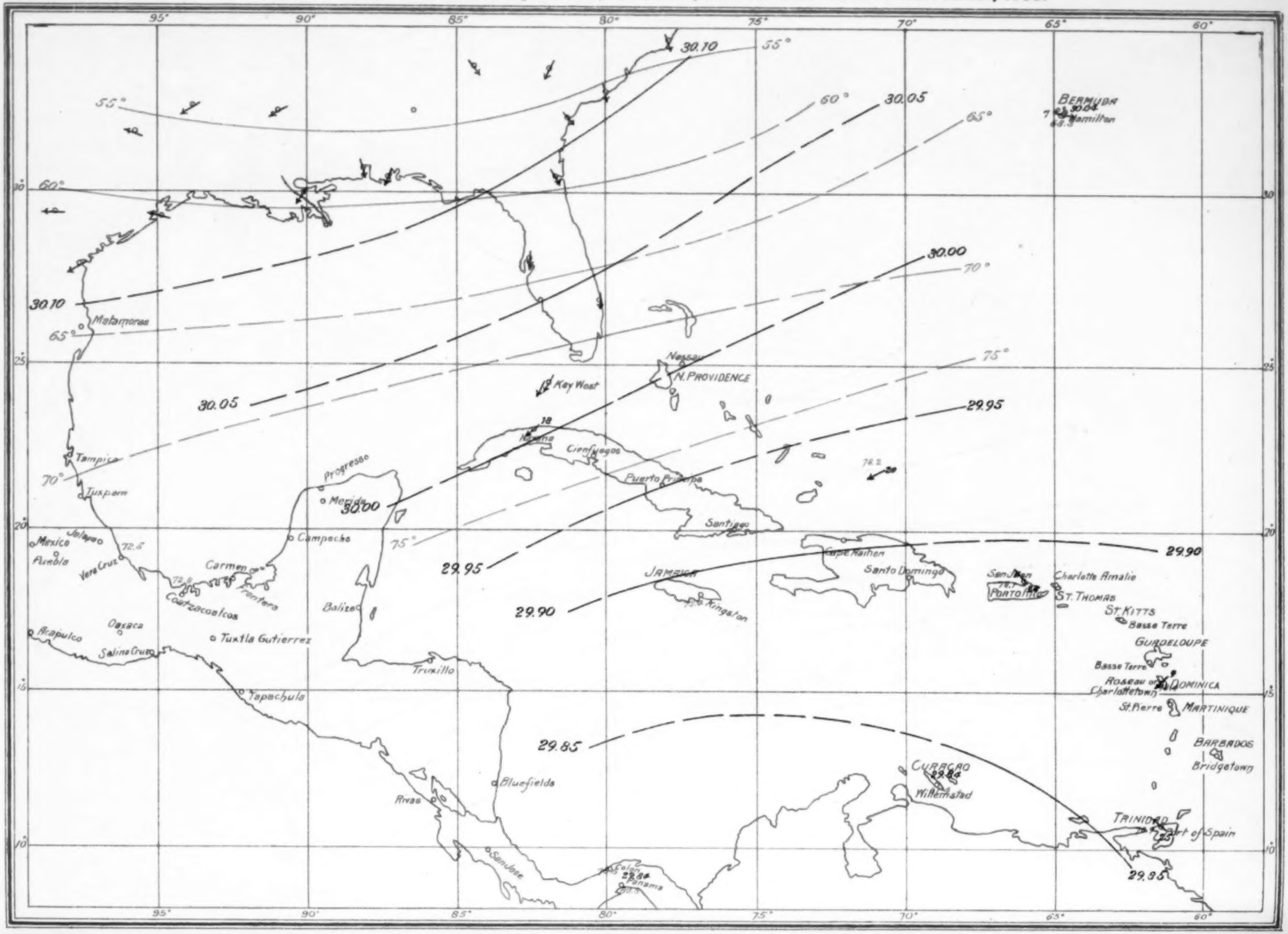


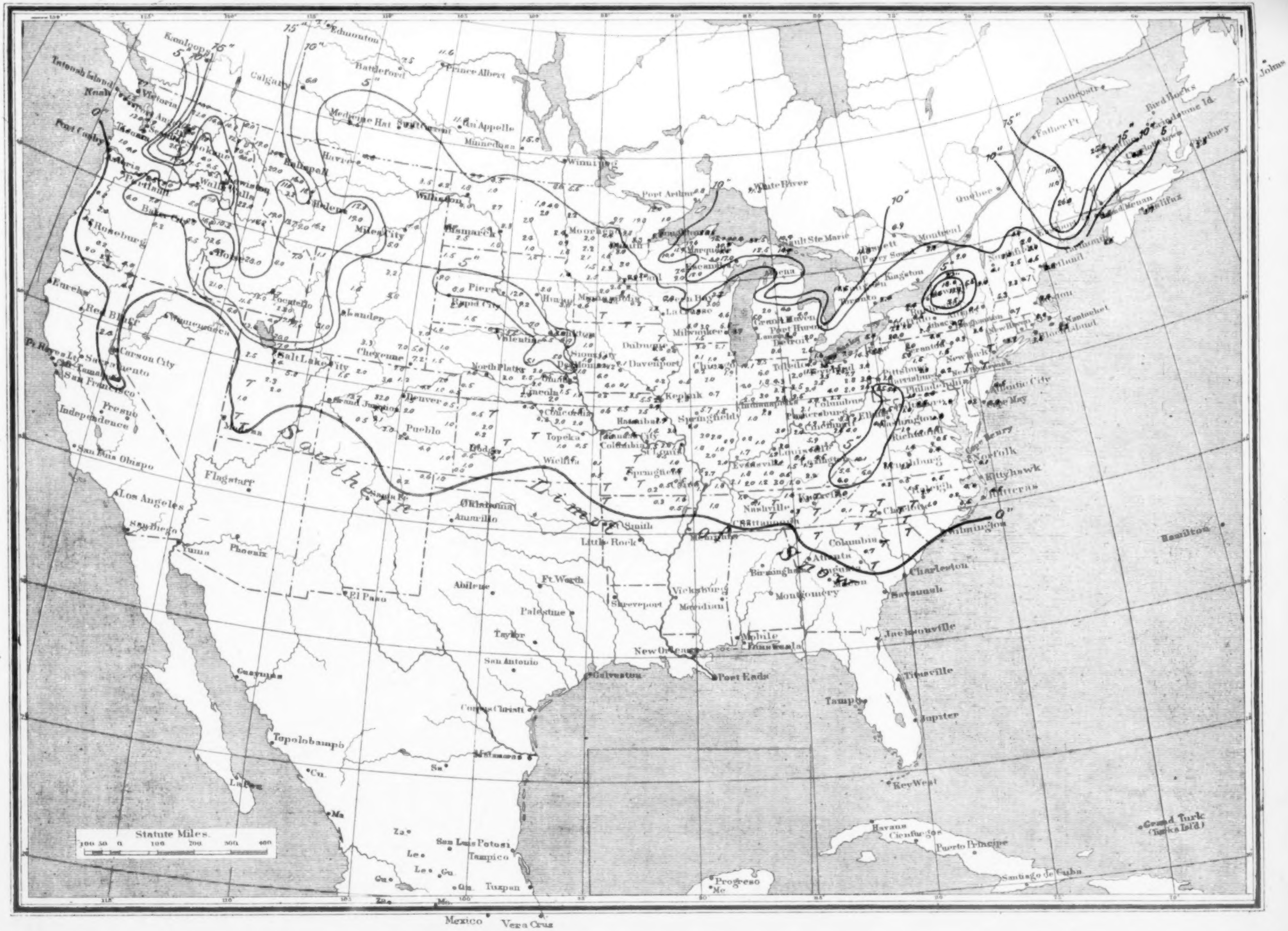
Chart X. West Indian Monthly Isobars, Isotherms, and Resultant Winds. November, 1903.



• Barkerville

Chart XI. Total Snowfall for November, 1903.

Chart XI. Total Snowfall for November, 1903.



XII. Depth of Snow on Ground, November 30, 1903.